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Classification and Storage of Wastewater from Floor Finish Removal Operations

Charles E. Hunt
(M.S. Thesis)

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ABSTRACT

CLASSIFICATION AND STORAGE OF WASTEWATER FROM FLOOR FINISH REMOVAL OPERATIONS

This study evaluates the wastewater generated from hard surface floor finish removal operations at Lawrence Livermore Laboratory in order to determine if this wastewater is a hazardous waste, either by statistical evaluation, or other measurable regulatory guidelines established in California Regulations. This research also comparatively evaluates the 55 gallon drum and other portable tanks, all less than 1000 gallons in size in order to determine which is most effective for the management of this wastestream at Lawrence Livermore Laboratory.

The statistical methods in SW-846 were found to be scientifically questionable in their application to hazardous waste determination. In this statistical evaluation, the different data transformations discussed in the regulatory guidance document were applied along with the log transformation to the population of 18 samples from 55 gallon drums. Although this statistical evaluation proved awkward in it's application, once the data is collected and organized on a spreadsheet this statistical analysis can be an effective tool which can aid the environmental manager in the hazardous waste classification process.

Rarely used methods of determining acute dermal toxicity, ingestion toxicity and inhalation toxicity were also applied and or discussed in the classification of wastewater from floor finish removal. These methodologies rely heavily on generator knowledge, material safety data sheets on the products, and toxicological reference data. Where all of this information is available and accurate, the acute toxicity of a waste can be evaluated with out the laboratory analysis outlined in the California Code of Regulations.

The comparative evaluation of portable containers found that although a best "all around" container could be found through use of a survey of those who used the containers that choosing a portable tank is more likely to be wastestream specific. Wastewater from floor finish removal operations necessarily must be managed through a specific, and limiting storage area. This small storage area, and availability of a small forklift strongly influenced the choice for the container most appropriate for wastewater from floor finish removal; the 625 gallon stainless steel tank. This stainless steel portable tank is not only small enough for use in the waste storage area but it has the advantage of having an excellent valve arrangement and a large, relatively light manway lid.

This study showed that when wastewater from floor finish removal was evaluated using statistical analysis, and other regulatory methods in determining toxicity, that it is non hazardous waste. In addition to this non hazardous determination, this study found the 625 gallon stainless steel tank to be most appropriate for the storage of this wastewater.

CLASSIFICATION AND STORAGE OF WASTEWATER
FROM FLOOR FINISH REMOVAL OPERATIONS

This Thesis is Written By

Charles E. Hunt

The thesis, written under the guidance of the Faculty Advisory Committee, and approved by all its members, has been accepted in partial fulfillment of the requirements for the degree of:

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at the

University of San Francisco

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CHAPTER 1

INTRODUCTION

Background

Lawrence Livermore National Laboratory (LLNL) is a large research facility which generates thousands of unique wastes. This research will evaluate the classification and on site storage of one of these wastes, wastewater from floor finish removal (scrubbing) operations generated in locations where radioactive materials do not pose a significant threat of cross contamination from radioactive material management areas (RMMA's). This research will focus on the statistical classification, and toxicological evaluation of the wastewater in order to determine if the waste is by definition a hazardous waste by California regulation. Additionally, this research will evaluate the portable containers used on site (LLNL) to determine which portable container is most appropriate for the management of this wastewater from floor finish removal.

Due to LLNL's continuous monitoring system of the waste waters discharged to the sanitary sewer lines destined for the Livermore Water Reclamation Plant (LWRP), the wastewater from floor finish removal triggered the sewer discharge alarm. This continuous on-line monitoring system can detect elevated concentrations of metals, radionuclides and pH. During the Spring of l992 an alarm was triggered at night by a high concentration of zinc. The maintenance crewman who monitors the sewer alarm system was aware that the custodial crew was working on a large floor (finish) stripping job that night, and suspected that the high zinc concentrations might be caused by this operation. Hazardous Waste Management was then contacted to obtain samples of floor finish, and to have this product sampled for metals. A concentration of 3200 mg/kg zinc was found in the floor wax product. California hazardous waste levels for soluble zinc as measured by the soluble threshold limit concentration (STLC) analysis using the Waste Extraction Test (WET) method is 250 milligrams per liter (mg/l). The STLC analysis is valid only for liquids where the solids content in the wastestream is equal to, or greater than .5%. The total threshold limit concentration (TTLC) analysis utilized in California determines if the total concentration of the contaminant (e.g. zinc) in the waste is hazardous or not. The TTLC concentration for zinc is 5000 milligrams per kilogram (mg/Kg). The analytical results of the zinc floor finish, along with analysis of samples obtained by the automatic sampler when the zinc triggered the sanitary sewer alarm, clearly indicated that this wastewater exceeded LLNL's wastewater discharge permit requirements of 15 mg/l by a factor of ten or more. The initial analytical results of the wastewater showed that this wastewater was not sewerable at these concentrations, but where inconclusive regarding the classification of the waste as hazardous.

The custodial supervisors were informed by the on site Environmental Protection Department (EPD) that this wastewater from floor (wax) finish removal from hard surface floors must be containerized and analyzed prior to disposal based on the initial analysis of this waste.

This policy of containerizing and analyzing each container of wastewater prior to discharge to the sanitary sewer, or disposal has become the standard practice for managing this wastestream at LLNL.

Initially each 55 gallon drum was analyzed for total (TTLC) metals, pH and radioactivity. Without exception, every drum of the custodial wastewater was found to exceed the LLNL sanitary sewer discharge level for zinc (15 mg/l). Three drums of custodial wastewater were found to exceed the California hazardous waste criteria of 250 mg/l for soluble zinc established via the STLC analysis. (The Resource Conservation and Recovery Act (RCRA) has not specified a federal standard by which a waste would be considered toxic for zinc concentration at this time.) After it was determined that this wastewater exceeded the hazardous waste criteria for zinc toxicity on three occasions, all wastewater from floor stripping was assumed to be a hazardous waste.

Continued analysis of custodial wastewater in 55 gallon drums also found pH, and metallic concentrations of lead, copper and silver above the sewer discharge limits. pH, lead and zinc concentrations were detected above their respective hazardous waste thresholds. Specific sources of these lead, copper and silver contaminants are unknown. Speculation is that these contaminants were from operations and activities inside the facility where the floor finish was being removed, in combination with metals from soil or dirt carried in on employees shoes.

Within six months of the initial discovery of this wastestream, it became apparent that the volume of custodial wastewater was of substantial size. During the period of May 1992 to May 1993, 6000 gallons of wastewater was containerized in 55 gallon drums and managed as hazardous waste.

Since analysis of the floor finish (wax) was the contributor of the high zinc concentrations in the wastewater, the Custodial Staff with in Plant Engineering (at LLNL) in June of 1992 switched from a zinc (metal interlock) floor finish to water based acrylic floor finishes which did not contain metals. This change to the non-zinc finish was made for the sole purpose of decreasing the toxicity of the wastewater generated from the floor finish removal operation.

Statement of the Research Problem

This research will examine historical analytical data on wastewater from floor finish removal operations from LLNL in order to determine how wastewater from floor scrubbing should be classified (hazardous or non-hazardous), as well as determine the best portable storage container for this wastestream at Lawrence Livermore National Laboratory.

Currently this wastewater, generated by the LLNL Custodial Staff from the scrubbing (removal) of zinc based floor finish, is managed as a hazardous waste because three drums (out of a 18) exceeded the toxicity criteria for zinc, and three other drums of this same set of 18 drums exceeded the upper corrosivity threshold. Every container of wastewater from floor finish removal that passes from Plant Engineering to Hazardous Waste Management is analyzed for: metals, pH and radioactivity. When ever this wastewater exceeds any of the regulatory thresholds it is managed in compliance with the appropriate regulations.

In March of l993, because of the time and cost of sampling each 55 gallon drum of wastewater from floor finish removal (mop water), Hazardous Waste Management (HWM) began bulking each 55 gallon drum of this waste into a 660 portable tank in the main waste storage yard (building 612) prior to analysis. Since this waste stream has been managed in tanks, considered containers by Laboratory definition, there has been no conclusive analysis showing wastewater from floor (finish) stripping to be a hazardous waste.

Subproblem One - Statistical Analysis

To determine by statistical evaluation of the historical analytical data of metals and pH analysis on mop water, if this waste is a California regulated hazardous waste or not.

Subproblem Two - Waste Toxicity

To determine if wastewater from floor finish removal, using all available information on the waste, meets any of the other definitions of toxicity as described in the California Code Of Regulations, Title 22, Section 22661.24.

Subproblem Three - Container Evaluation

To determine which of the portable containers (55 gallon drum, 330 gallon polyethylene "tuff tank", 660 gallon polyethylene tank, 625 gallon stainless steel tank, 750 gallon stainless steel tank, secondarily contained 500 gallon polyethylene tank, or 500 gallon polyethylene globe) is best suited for the storage and on site transportation of mop water.

Hypothesis

That the statistical evaluation of analytical data, evaluation of the process knowledge and toxicological data when applied to the California regulations on hazardous waste will indicate that this wastewater from floor finish removal is not a corrosive, or toxic waste. The additional hypothesis is that this waste is more appropriately managed in a portable tank.

Subhypothesis One

The statistical evaluation of all historical analytical data from 55 gallon containers of wastewater from floor finish removal as described in the *Test Methods For Evaluating Solid Waste: Physical/Chemical Methods SW-846* (SW-846) will show that this waste is not a hazardous waste.

Subhypothesis Two

Evaluation of all available information on wastewater from floor finish removal, in conjunction with toxicological reference books, when applied to the toxicity criteria set forth in the California hazardous waste regulations will show that this waste is not toxic.

Subhypothesis Three

Research on portable containers and site specific waste management strategies, in conjunction with information provided by the LLNL technicians who use portable tanks, will indicate that this wastestream should be managed in a portable tank.

Assumptions

The primary assumption to this study is that this wastestream is not sewerable and therefore must be containerized.

The second assumption is that the toxicity and corrosivity of the waste is based only on the historical analytical data of metals and pH, used in conjunction with the material safety data sheets (MSDS's) of the primary floor finishing products.

The third assumption is that the Waste Extraction Test (WET) method in determining the soluble fraction of the metals within a waste is more stringent than the comparative federal test for toxicity: the Toxicity Characteristic Leaching Procedure (TCLP). Although these analysis are technically different, the California Environmental Protection Agency (CAL-EPA) supports this assumption.

The fourth assumption is that the wastewater is generated by the Lawrence Livermore Lab's custodial crew following a consistent procedure on floor stripping using only four primary products in their floor care operation: Buckeye Mainstream (non-zinc) Floor Finish, Buckeye First Down Floor Sealer, Revelation Finish Remover, and Straight Up floor cleaner.

The fifth assumption is that wastewaters generated from these floor finish removal operations are homogeneous, with no significant changes in the waste generation process.

The sixth assumption is that the statistical methodologies found in SW-846 can be applied to the data on wastewater from floor finish removal operations for the purpose of determining if this waste is hazardous or not.

The seventh assumption is that the strategy of storing large volume waste streams in large containers can be applied to other waste streams at LLNL.

The eighth assumption is that the toxicity of the wastewater can be accurately evaluated using the current floor care product data sheets in conjunction with the historic analytical data.

Delimitation's to the Study

This research will be limited to the characterization, and on-site storage of wastewater from floor finish removal at the Lawrence Livermore Laboratory site.

This research will not utilize the written narrative definition of a toxic waste in assessing the toxicity of the wastestream. This regulatory definition of hazardous waste: "...a waste that has been shown through experience or testing to pose a hazard to human health or the environment due to its carcinogenicity, acute toxicity, bioaccumulative properties or persistence in the environment." although informative, is extremely difficult to evaluate.

This research will not address the process by which the waste is generated, treated or disposed of.

This research will not evaluate waste minimization strategies for the generation of wastewater from floor finish operations, or alternative products which may be used in the generation of the waste.

This research will not evaluate radioactive constituents in the wastestream, as a potential factor in evaluating the toxicity or corrosivity of the waste.

Methodology

Two methodologies will be utilized to address the three subproblems of this study. Waste classification will be researched by a combination of the analytical survey method and the statistical method; on site storage of floor finish wastewater will be researched with the descriptive survey method.

In determining the hazardous classification of the wastewater, approximately a years worth of analytical data will be analyzed statistically. This analysis will generally following the protocol described in SW-846, Chapter 9 under the heading "Strategy For Determining If Chemical Contaminants Of Solid Wastes Are Present At Hazardous Levels - Simple Random Sampling. "The statistical analysis of the data will look closely, through graphical representation, at the different data transformations; arcsine transformation, and square root transformation outlined in SW-846. A third statistical transformation applied to this subproblem will be the log normal transformation, as described in Statistical Methods For Environmental Pollution Monitoring, R.O. Gilbert, 1987. These three transformations will be applied to analytes which were above hazardous waste thresholds at least once. These analytes include: zinc, lead and pH. Based on review of the statistical evaluation of lead, zinc and pH, a determination will be made on the classification of this wastestream as hazardous or non-hazardous. A comparative chart will be generated to summarize the different data transformations, and their relevance to waste classification at LLNL, and the regulated community as a whole.

The classification of this waste as toxic or not by methods other than statistics will generally following the CAL-EPA document: *Waste Classification Regulation Guidance Manual,* l993. In this guidance document the different methods of evaluating toxicity are briefly described.

1. Acute oral toxicity. Evaluated using the "oral rat LD_{50}" where the toxic dose is given during a single administration. The regulatory threshold (RT) for the acute oral toxicity is 5000 mg/kg.

2. Acute dermal toxicity. Evaluated using the "dermal rabbit LD_{50}" where the toxic dose is applied to the skin for a 24 hour period. The RT for the acute dermal toxicity being 4300 mg/kg.

3. Acute inhalation toxicity. Evaluated using EPA method 5020 to determine if any of the headspace gases with specific LC50 thresholds, or LClo thresholds less than 10,000 ppm have been exceeded.

4. Cumulative dermal or oral toxicity as evaluated by the protocol written in CCR Title 22 Section 22261.24.(c).

5. Acute aquatic toxicity. Evaluated using the "fish bioassay" where the toxic dose of 500 mg/l is evaluated in an aquatic environment for 96 hours. The acute aquatic toxicity LC_{50} equals 500 mg/l.

6. Chronic Toxicity: Where the constituents of the waste determined by generator knowledge or testing are compared to the list of known materials listed in CCR 22 Section 66261.24(a)(7). Where the constituents in the waste can be found on this list of chemicals, and exceed the RT of .001% by weight (10 ppm), the waste is toxic.

These different methods used in toxicity determination will be applied to wastewater from floor finish removal, and a determination will be made if the waste is toxic or not for each criterion.

The third subproblem, choosing the appropriate container for wastewater from floor finish removal will be evaluated by the descriptive survey method. Information on portable tank usage by the LLNL technologists acquired from a survey, and investigative research into the containers themselves will be evaluated and summarized on a comparative chart. This chart will then be used, in conjunction with site specific information, in determining the best container for waste mop water.

Definitions

Definitions will be provided in appendix one. Appendix one is a copy of the "Definitions" provided in section 66260.10. of Title 22, the California hazardous waste regulations. Where additional terms specific to this research are used, they will be described in the body of the text.

Importance of the Study

This study will be important for several reasons. It will utilize and apply accepted although rarely used statistical methods for determining if a waste is toxic or "hazardous waste" at Lawrence Livermore National Laboratory. Currently, the majority of hazardous wastes at LLNL are evaluated on a container by container basis. This research will evaluate historical analytical data using accepted statistical methods to determine if the yet to be filled container of an established waste stream should be considered hazardous or not. In the case of mop water for example, if 100 drums if this waste is generated annually, and the first ten drums are analyzed individually and one drum is found to be hazardous, how do you legally and accurately determine how to label the eleventh drum?

The hazardous waste determination at LLNL is extremely important. Once the waste is called hazardous, and it's a liquid waste, it must be stored, when filled, in a "waste accumulation area" (WAA) and be secondarily contained. The classification of waste mop water as a hazardous waste would significantly impact the liquid storage capacity of Plant Engineering's WAA. Classifying the mop water wastestream as non-hazardous would allow this waste to be stored in any safe location, outside of a WAA, without secondary containment.

The determination of the toxicity of mop water is also important because of it's implications for classifying other wastes at the Lab. Many industrial wastes are generated at the Lab with a potential for toxicity; if these wastes are managed as hazardous waste for their potential to be hazardous as opposed to their actual toxicity, this increases LLNL's operational and environmental costs significantly.

Outside of the Lab, the classification of wastewater from floor stripping is also very important. Zinc floor finishes are widely used by facilities having hard floor surfaces, commonly tile or linoleum. Zinc based floor finishes, because of their excellent quality, have 90% of the market share for all industrial floor finishes (Gindling l995).

LLNL's historic analytical data on mop water has shown that although the waste is generally non-toxic, it has never been below the sewer discharge levels. Consequently, many schools, retail stores, hospitals, and other "clean industries" may be impacted by the knowledge that this wastewater generated by scrubbing of zinc floor finishes should not be discharged to the sewer system without treatment or analytical verification of it's sewerability.

The awareness that zinc floor finishes and their maintenance commonly produces a waste stream that is non-sewerable and potentially hazardous, should focus the manufacturers of floor finishes, and the consumers of their products, on alternative floor finishes, floor maintenance strategies, and floor surfaces that do not require costly special waste handling and disposal.

Evaluation of storage options for wastewater from floor finish removal will show some of the operational and regulatory advantages for utilizing a portable tank as opposed to a 55 gallon drum. This study will show portable tank storage to be a superior approach for on site storage for the following reasons:

1. Reduction in environmental compliance responsibilities.
2. Reduced documentation and record keeping.
3. Cost saving from reduced sampling and analysis.
4. Reduced empty container management.

The transportation and transferring of waste mop water in drums is more time consuming and awkward then managing the waste in a portable tank. A 625 gallon tank of mop water is equivalent in volume to eleven 55 gallon drums. Eleven drums of mop water when transported by forklift requires 6 trips from the WAA to the 612 facility where they are bulked into a portable tank. If the mop water was initially stored in a portable tank, only one trip by a heavy duty forklift is required for transfer to building 612; more importantly the bulking of the waste from drums to tanks is eliminated. Environmental compliance responsibilities, documentation, and record keeping are reduced by the reduction in the number of containers eliminated by using a portable tank. Each individual container of waste, regardless of size must have a label and a descriptive "requisition". All wastes managed on a requisition are subject to inspection and review. By managing the waste in drums you increase the time required for inspections, and the opportunity for a mistake on a label, which is a potential regulatory violation. Each requisition is input into a computer system and is tracked on-site until the waste is transported off-site. Once the waste has left the Lab, the requisition is archived indefinitely on site. By altering the storage of the waste from a drum to a tank, the paperwork load is reduced by a factor of ten.

Sampling and analysis is also container dependent, not volume dependent. So, by using a larger container, fewer samples and analyses are required for the management of any given waste. For waste analysis, utilizing a portable tank is quite significant because of the reduction in cost. Sampling and analysis of a hazardous waste is expensive. Where a 625 gallon tank can be utilized in association with a larger volume waste, instead of drums, thousands of dollars in analytical costs can be saved annually.

Mop water also poses an additional problem when it is managed in a drum. Operationally LLNL found it impossible to completely empty 55 gallon drums of mop water. During the transfer of the wastewater from drums into the portable tank, the sludge in the bottom of the drums could not be removed by the transfer pump; consequently the Lab was generating a secondary waste stream: 55 gallon drums with residual sludge high in zinc, which is also managed as a hazardous waste. By eliminating the storage of mop water in drums, and using a portable tank which can be cleaned and reused, this secondary waste stream is eliminated.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

Methods Utilized

In completing the review of literature on the classification and storage of wastewater from floor finish removal, this research focused on the following: the method and process where by floors are finished and maintained; state and federal regulations relating to hazardous waste classification and hazardous waste storage; waste sampling; statistical evaluation of waste; wastewater analysis; case law on hazardous waste classification; and lastly a case study of the Kaiser Permanente Medical Facility in Petaluma California, where wastewater from floor finish removal was classified and managed as a hazardous waste.

This information was obtained primarily from three libraries and their associated stacks and databases: University of San Francisco, University of California at Berkeley and the Lawrence Livermore National Laboratory Library. Literature regarding the Kaiser Medical Facility was obtained from the wastewater operator from the City of Petaluma (Swift 1994).

Currently little information has been documented in the literature on the classification of wastewater from floor finish removal as a hazardous waste. However, it is understood by word of mouth (Fishbaugh 1993; and Gindling 1995) for those in the industry, that wastewater generated from the removal of metal interlock (zinc containing) floor finishes can be a problem for industries which have waste discharge requirements, and mandatory wastewater monitoring as part of these requirements.

Hard Surface Floor Maintenance

Floor maintenance is carried out to provide attractive, comfortable, healthy and safe surroundings and to expedite the productive function of the facility. The proper maintenance of a hard surface floor (tile, vinyl, or painted cement) also serves the additional purpose of protecting the floor surface, thereby increasing its useful life and preserving its appearance.

Floors receive an estimated 90 percent more wear than any other part of the building and account for about 40 percent of the over-all cost of building operations. The cost of maintaining a building over a period of twenty five years is approximately the same as the original cost of the building (Edwards l972). When it becomes clear that floor maintenance represents a substantial financial cost, it is obvious that correct floor maintenance represents a large financial investment.

Floor maintenance includes three elements: labor, equipment and supplies. The number of times each maintenance operation (e.g.. floor cleaning, floor finishing, floor stripping) is conducted is of prime importance. This maintenance frequency is a function of three basic variables: amount of traffic, level of appearance desired and type of area to be cleaned.

Labor is the major cost factor in any floor maintenance program. Typical maintenance operations for a resilient floor that might be measured for an analysis of maintenance costs are: sweeping, mopping, scrubbing, waxing, polishing (including burnishing) and stripping. More recently, the training of the floor maintenance personnel is being understood as an important consideration in evaluating the total floor maintenance cost.

A good training program in floor maintenance is an essential element in the proper care of resilient floor surfaces. "Proper training goes hand in hand with effective floor care, especially in a company of this size," says Don Churchill (1991) director of corporate purchasing for Walgreens.

Floor maintenance often requires more consideration and effort than other types of routine maintenance. The constant wear due to traffic, and the accumulation of dirt and soil transferred from shoes and deposited from the air are factors that increase the floor maintenance problem.

The difficulty of maintaining floor surfaces is determined by the nature and age of the accumulated soil, grease, food crumbs, waxes or other materials that may have been left on the floor. The longer the waste material is allowed to remain on the flooring the more difficult it is to remove.

Untreated, or unsealed flooring poses an additional problem during floor maintenance. Untreated hard surface flooring is somewhat porous, and is often softer than the contaminants that may accumulate on the surface. Consequently, normal foot traffic will grind the soil and other contaminants into the pores of the untreated floor surface and act as an abrasive in scratching and wearing the surface (Berkeley l968).

Floor finishes provide an attractive, clear, protective and temporary removable layer over the floor surface. It has been proven that finishing of all resilient floor coverings is advantageous and desirable. In the case of industrial and institutional maintenance, it has been shown that the use of floor finish can reduce the cost of maintenance by lowering the labor cost, because less time is required to keep up the appearance. Therefore the regular maintenance of resilient floor coverings by finishing (polishing) is recommended (Berkeley l968).

Floor finishes can be classified in different ways, either by function or composition. Using function as the criterion, floor finishes can be segregated into two main classes: floor sealers and floor waxes (polish).

A seal can be defined as a semi-permanent material which protects the floor from the entry of dirt, stains and other contaminants. Nearly all floors are porous to a certain extent and by filling the open pores and providing a wear surface, the life of a floor can be extended almost indefinitely (Edwards l972). A sealer differs from a floor wax in it's primary function, which is to penetrate, and seal the floor surface from contaminants. A floor sealer has the same function as a "primer" does for a painted surface. Sealers, to be effective must provide a good bond to the floor surface, and provide a base coat, with good bonding and adhesive qualities for the wax coats which are applied on top of it. Floor sealers like waxes, are buffable and protect the floor surface.

Floor wax (finish) provides the attractive protective layer on top of the sealer. The other characteristics of floor waxes will be described after the classification of waxes by their composition.

There are two primary formulations of floor waxes: solvent based wax and water based emulsion floor waxes. These two major classes of waxes can be further subdivided based on composition and form.

The two types of solvent based waxes are the liquid solvent wax and the paste solvent-based wax. These solvent waxes are made up of a mixture of waxes and other ingredients in a solvent base. The solvent in the solvent based wax is a petroleum distillate. This mixture is generally ignitable. The petroleum solvent based waxes should not be used on asphalt, thermoplastic tiles, PVC (vinyl) asbestos tiles because they have the ability to dissolve a portion of the floor surface itself. Solvent waxes are correctly used on the following surfaces: wood, cork, wood composition and linoleum surfaces.

It has been documented that solvent based floor waxes contribute significant air borne contaminants (volatile organic hydrocarbons), and may contribute to "sick building syndrome" (Weschler l990) and cancer. A study by Norell (1986) has associated floor cleaning supplies and floor waxes to pancreatic cancer in humans.

Water based emulsions represent the other main category of waxes. Water based emulsion waxes have a considerable advantage over solvent based waxes in that much harder waxes can be incorporated. The wax layer in water based emulsion waxes are more durable, harder wearing and more resistant to heat than that given by solvent based waxes. Water emulsion waxes are composed of a wax and an alkali-soluble resin or shellac.

Within the last fifteen years "metal interlock", water based finishes have been introduced. These water based, metal interlock finishes utilize a zinc compound to improve the strength and durability of the floor wax (Fishbaugh l994). It is this zinc component of the water based emulsion floor wax that, when stripped off a hard surface floor, exceeds Lawrence Livermore Laboratory wastewater discharge requirements by a factor of 10 or more (Lawrence Livermore Laboratory's discharge level for zinc is 15 mg/l).

Water based emulsion resins and polymers (acrylics and polystyrene), or synthetic waxes, form the other category of water based emulsion floor finishes. These products are a dispersion of synthetic resins, polymers, and modifying materials in a water base. Currently it is this form of wax that is being used in the sealing, and finishing of the floors on the LLNL facility. Water based resins and polymers may be used on all resilient floors except cork. These waxes do not contain the problematic zinc component of the metal interlock water based emulsions; but they lack the durability of the metal interlock water based emulsions.

A good floor wax will have certain traits: ability to resist indentation; slip resistance; and light reflectance. A floor wax having a greater solids content will be harder, and resist the indentation by objects stored on the floor surface. Slip resistance is an extremely important quality of the floor wax because of the potential for liability due to a slip or fall accident.

An essential quality of a floor wax from an institutional prospective is that it provides a predictable, easily maintained and non-hazardous walking surface (Chain Store Age l991). According to ASTM D 2047, products that meet or exceed a coefficient of friction of 0.5 or greater have traditionally been recognized as providing non-hazardous, slip resistant, walking surface for pedestrians. There are several common misconceptions held regarding the slipperiness of waxed floors: waxed and polished floors are slippery;

shiny floors are slippery; a just waxed floor is more slippery than a previously waxed floor; buffing a floor makes it more slippery.

Testing of the floor finishes have found that the floor finishes applied to the floor surface do not generally make a floor slippery, wet surfaces on a floor, however, does increase the slipperiness of a floor substantially and poses a health hazard. Floor surfaces coated or treated with silicone can also increase the slipperiness (decrease the coefficient of friction) of a floor.

Light reflectance as a floor wax property, is important because of its influence on cleanliness and appearance. "Retail operators say that a high-gloss floor sends out positive signals to customers (Chain Store Age l991). "Shoppers associate a clean floor with a clean store, "says Earl Amis, design manager, Safeway Stores. "High appearance levels, which for us translates into a high gloss, rank high on our list of priorities." As with all major characteristics of floors and floor maintenance supplies, American Standards of Testing and Materials (ASTM) has developed a standard for gloss as it relates to floor wax: D 1436-93; Test Method for 60 degree Specular Gloss of Emulsion Floor Polish.

The ability of a floor wax to "powder" upon high speed polishing (buffing and burnishing operations) is also notable. During the buffing operation, small particles of the wax are abraded into particles and become air borne. These air borne particles become an appearance problem because of their fallout onto shelves and other items close to the floor surface.

Resistance to detergent is another important quality of a floor wax. Ideally it is best to provide a floor and wax combination which is resistant to the detergent used to clean the floor surface. The goal is to use a detergent to clean the floor thoroughly without removing any of the protective, attractive wax coating.

Freeze/Thaw Stability (see ASTM D3209) is the measure of the wax products ability to withstand temperature change. This trait has regional importance; clearly facilities of the north-east where there is a larger seasonal difference in temperature are concerned much more with the climatic effects on floor wax.

Scuffing, scratching and marking resistance is another characteristic that is highly valued in a floor wax. ASTM has developed Test Method D 3714-87 for the testing of a floor waxes ability to resist black marking.

The previously mentioned floor finish qualities should point out the key qualities which should be considered when choosing a resilient floor finish. These floor waxes and sealers should be combined with appropriate floor cleaning materials to provide an economic and effective floor care program.

What constitutes a good floor cleaning program will vary depending on the type of facility, volume of foot traffic, and age of the flooring. However, all good floor cleaning programs will have the following elements:

1. Entrance mats will be used to minimize the amount of dirt and other contaminants that are carried onto the floor surface in the first place.
2. Dry mopping, vacuuming or wet mopping should be completed daily. This routine cleaning should remove approximately 90% of the dirt and debris on the floor. Wet mopping with rinsing of the mop head does a more thorough cleaning than dry mopping or vacuuming.
3. Following a wet or dry mopping, depending on site conditions, a combination cleaner-wax should be applied weekly. This cleaner-wax should than be buffed, or burnished to provide gloss and increased durability of the floor finish.
4. Again depending on site conditions the floor should be cleaned or "lightly scrubbed" every three to six months. This light scrub should remove about half of the wax coating on the floor surface. Commonly, the wastewater from the light scrub will be picked up with a wet/dry vacuum followed by a rinsing/mopping of the floor with clean water. An

application of two wax coats will follow the rinsing operation (Fishbaugh l994). The least frequent step in floor cleaning is a complete floor finish removal or stripping

Floor stripping is required when the residual dirt becomes noticeable after routine cleaning, appearing as a generally graying in the traffic lanes. In addition to the accumulation of dirt and other contaminants, a gradual build-up of wax behind doors, along the edges of corridors, and in light traffic areas will occur. When this wax builds up in lightly used areas and becomes unattractive, the floor should be stripped, or heavily scrubbed, to remove all of the floor finish, down to the sealer. The time between floor stripping varies significantly; from as often as every two months to 18 months depending on site conditions.

Floor finish removing compounds, or floor strippers may serve a dual purpose, that is, they serve as finish removers at high concentrations, and cleaning compounds at lower concentrations. These cleaners commonly contain ammonia or organic amines which act as re-emulsifying agents for the dried floor wax. These ammonia containing cleaners are quite effective, but have an offensive odor (Berkeley l968). Ammonia has the advantage of being volatile, therefore it doesn't leave a residual film on the floor.

Since the floor stripping compounds must be powerful cleaners, it is essential that they are recommended for the particular resilient floor under consideration. Generally, the products recommended for maintenance of resilient floors are: liquid compounds with a soap or synthetic detergent base that are neutral or mildly alkaline (Berkeley l968). Both the Rubber Manufacturers Association and the Asphalt and Vinyl Asbestos Institute have established standards for products of this type, and most floor cleaning compound manufacturers adhere to the recommendations of these organizations.

Care must be exercised in the floor stripping process. Floor finish removal necessarily involves a soaking of the cleaner on the floor finish; this is accomplished in order to minimize the scrubbing and scouring process, which may damage the floor surface. Concerns have been raised regarding the generation of air borne asbestos from floor stripping operations (Wilmoth l992). Alternatively, if this strong cleaning solution is left to long to soak on the floor, it can penetrate between seams or joints to the adhesive and cause a warping of the floor and loosening of the tiles.

The final, and perhaps the most important step of floor stripping is the rinse and squeegee step. After the floor has been soaked and scrubbed, the wastewater must be collected and removed from the floor surface. The squeegee is used in the collection of the wastewater on the floor surface. This wastewater containing the residual cleaner, floor wax and other contaminants is then collected in wet/dry vacuums for disposal. This step is not only important in achieving a clean floor, but it prepares the flooring for the acceptance of a floor sealer.

Summary: Hard Surface Floor Maintenance

In the understanding of the wastewater from floor maintenance it is essential to have an understanding of the process of its generation. The process of wastewater generation from resilient floor maintenance is more complex than it appears from first blush. There are many types of resilient flooring, with different characteristics and different composition. Each class of flooring; e.g. vinyl asbestos tile, has a corresponding maintenance and cleaning regime that corresponds to its care.

The maintenance of floor care also is multifaceted. In choosing a floor maintenance strategy you must determine how important it is to protect and beautify the floor, and justify your decision with an appropriate budget. Armed with a knowledge of flooring and a strategy for maintaining your floor; a floor maintenance program can be implemented. Information from the American Standards of Testing and Materials; Rubber Manufacturers Association; Asphalt and Vinyl Tile Association along with other trade organizations can help develop a floor maintenance program that will meet the requirements of the facility of concern.

The environmental issues of potential asbestos exposures from floor stripping and volatile organic emissions from solvent based floor waxes appear in the literature. Only one article 'Earth Friendly Metal Free Floor Finishes' (Chain Store Age Executive July 1992) addressed the problem of metals in floor finishes. The fact that wastewater from floor wax stripping is not addressed in the literature is significant by its omission.

Hazardous Waste Classification via California Regulation

Waste classification is perhaps the most interesting, and controversial quality of waste management. Waste classification is highly regulated yet poorly understood by many significant waste generators. This research will describe the California and Federal regulations as they relate to hazardous waste determination.

Waste classification regulations are specifically addressed in Title 22, Division 4.5 of the California Code of regulations. Title 22 Section 66260.200., the first section addressing waste classification, is titled: "Classification of a Waste as Hazardous or Non-hazardous". The first key point regarding waste classification in this section addresses regulatory violations; see part (c): "A generator who incorrectly determines that a hazardous waste is non-hazardous and fails to manage the waste pursuant to the provisions of this division is in violation of the requirements of this division and is subject to enforcement action". This statement clearly has the intent of having the generators manage their waste as a hazardous waste until they have documentation or precedent indicating that the waste is truly a non-hazardous wastestream.

For a waste to be hazardous waste, it must meet the definition of a hazardous waste as described in Article 3 of Chapter X (ten). A waste is considered hazardous if it meets any of four hazardous characteristics: toxicity, ignitability, reactivity, or corrosivity. These characteristics for selected chemicals, can be determined by specific analytical methods referenced in section 66260.11. An important alternative to evaluating the waste characteristics through chemical analysis is through the use of "generator knowledge". For a generator to characterize a material as hazardous, the hazardous property must be "...reasonably detected by the generator of the waste through their knowledge of the waste." In addition to these characteristics, section 66.261.24. includes a narrative definition of hazardous waste: "A waste exhibits the characteristic of toxicity if representative samples of the waste have shown through experience or testing to pose a hazard to human health or environment because of its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistence in the environment."

For the waste generator, this narrative definition of hazardous waste, which is open to a variety of interpretations, should be viewed with the concept of liability of improper characterization as described in section 66260.200. What these regulations are saying is, that even though we have tested this waste, and have found it to be non-hazardous by all characteristics, this waste may indeed be hazardous because it has been shown to pose a threat to human health or the environment. Fortunately, there are some exemptions to these California regulations. Several exemptions to the California hazardous regulations are described under section 66261.4. These exemptions are given for the following wastes under specific conditions.

1 Industrial wastewater discharges that are point source discharges subject to regulation under section 402 of the federal Clean Water Act. "This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment." (This particular exemption would seem to apply for wastewater from floor finish removal, particularly if this wastewater was discharged first through a simple treatment unit such as an oil - sand separator.)

2 Special nuclear materials; commonly known as radioactive waste.

3 Sulfuric acid wastes from certain processes.

4 Certain infectious wastes, and medical wastes.

5 Federally exempted wastes pursuant to 40 CFR section 261.4 if they don't exhibit a California characteristic of hazardous waste.

6 Certain wastes generated in product tanks, or raw material storage tanks, or pipelines as exempted under the California Health and Safety Code section 25153.6.

7 Samples of waste, under most conditions.

8 A controlled substance (illegal recreational drugs) under the control of a peace officer or appropriate government agency.

In addition to the hazardous waste exemptions listed above, it is also possible to obtain a variance, allowing particular wastes to be managed as non-hazardous wastes. Variances for hazardous waste are addressed in sections 25143, 25150 and 25151 of the California Health and Safety Code.

Variances from regulation under California hazardous waste laws are granted for non-RCRA wastes; wastes which do not meet the definition of a hazardous waste as described in the federal regulations. The California hazardous waste enforcement agency, CAL-EPA, may issue a variance for two reasons:

1. "The hazardous waste, the amount of the hazardous waste, or the hazardous waste management activity or management unit is insignificant or unimportant as a potential hazard to human health and the environment".

2. "The handling, processing, or the hazardous waste management activity, is regulated by another governmental agency in a manner that ensures it will not pose a substantial present or potential hazard to human health and safety, and the environment."

A variance for the management of the waste as a non-hazardous waste may be granted by CAL-EPA only after a complete and thorough review of an application for a variance, submitted by a waste generator.

In addition to obtaining a variance for managing the waste as hazardous, Title 22, Section 66260.200. provides a waste generator the option to obtain "departmental concurrence" (see appendix B) on the classification of a waste as a non-hazardous waste. This thorough and time consuming process would remove the liability of the improper characterization of a waste as non-hazardous waste. Within this section is one additional avenue for classifying a non-RCRA (also known as a California only hazardous waste) waste as a non-hazardous waste. Part (f) of section 66260.200 allows for a person to "classify and manage a non-RCRA hazardous waste because it has mitigating physical or chemical characteristics which render it insignificant as a hazard to human health and safety, livestock and wildlife, that person shall apply to the Department for its approval to classify and manage the waste as non-hazardous." This application for management as a non-hazardous waste is comprehensive.

Hazardous Waste Classification via Federal Regulation

Waste Classification is codified federally in CFR 40 part 261. The starting point within part 261, for determining the full scope of RCRA's coverage is in the broad definition of a solid waste (Arbuckle 1993). "The term "solid waste" means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining and agricultural activities and from community activities but does not include solid or dissolved materials in irrigation return flows or industrial discharges which are point sources subject to permits under section 402 of the Federal Water Pollution Control Act, as amended, or source, special nuclear, or by-product material as defined by the Atomic Energy Act of l954, as amended" (RCRA, Section 1004). Thus a waste can be a solid waste, regardless of its physical form: solid, liquid, or gas.

A hazardous waste under the Federal definition is a "solid waste", or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may: cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

"These interlocking definitions result in EPA regulating a universe of materials that may not commonly be understood to be "wastes" for a particular industry or company. In particular, materials that will be reclaimed or recycled, rather than disposed of, may still be considered solid wastes and therefore hazardous wastes subject to RCRA regulations" (Arbuckle l993). 40 CFR part 261 automatically exempts certain solid wastes from being considered hazardous wastes. Generally these exemptions from federal hazardous waste regulation include:

l. household waste
2. agricultural wastes which are returned to the ground as fertilizer
3. mining overburden returned to the mine site
4. utility wastes from coal combustion
5. oil and natural gas exploration drilling waste
6. wastes from the extraction, beneficiation, and processing of ores and minerals, including coal
7. cement kiln dust wastes
8. arsenical-treated wood wastes generated by end users of such wood
9. certain chromium-bearing wastes.

If a solid waste doesn't qualify for any of the exemptions, it will be deemed a hazardous waste if: it is a "listed waste" under 40 CFR part 261 Subpart D; or if it exhibits any of the four characteristic of a hazardous waste: toxicity, corrosivity, ignitability or reactivity.

40 CFR Subpart C describes the criteria for identifying and characterizing a federally "listed" hazardous waste. The EPA has established three different lists. The first list is from nonspecific sources, for example spent halogenated solvents (carbon tetrachloride) used in the process of degreasing. These nonspecific wastes are placed on the "F" list, and assigned a number, FOO5, for example.

The second list of hazardous wastes are the K wastes. These wastes are from specific sources such as: Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane. This waste stream is given an EPA hazardous waste number of K097.

These first two lists are largely self explanatory. In determining if a company's solid wastes are hazardous, they need to compare them to these lists. In evaluating if a specific chemical is on either of these lists it is essential that the process in generating the waste is evaluated carefully (Crawford 1995).

The third list describes commercial chemical products, including off specification materials, containers, and spill residues. There are two sublists contained in this third list: the P wastes and the U wastes. The "P wastes" itemizes specific chemicals, e.g. fluorine, which are considered "acutely hazardous wastes". These acutely hazardous wastes are subject to more rigorous regulation than a hazardous waste. The second sublist sets forth the "U listed wastes". The U listed wastes include off specification commercial products, or any spilled material, or contaminated debris that has been contaminated with a U listed material.

40 CFR Part 260.22 describes the requirements for having a particular waste stream "delisted". If a hazardous waste is delisted, it is not considered a hazardous waste under federal law. If a waste generated in California is "delisted" from the federal list, it is

probable that this waste is a hazardous waste under California regulation. A waste generator has the option to petition the EPA for a regulatory amendment to have their waste streams removed from any of the lists. This is a painful procedure involving a comprehensive application to the EPA demonstrating that this waste does not exhibit any of the hazardous waste characteristics (toxicity, ignitability, reactivity, or corrosivity), and that the waste does not warrant retaining the listing as a hazardous waste. If a facility is lucky enough to have their waste stream removed from any of the lists, their waste stream will be codified in regulations in 40 CFR appendix IX of Part 261.

If a particular waste stream is not listed, it may be a hazardous waste because it exhibits any of four characteristics: toxicity, ignitability, corrosivity, or reactivity. These characteristics, very similar to those described in California regulations, can be evaluated through the acquisition of a representative sample of the waste and subsequent analysis at a certified analytical laboratory. If a waste exhibits any one of these characteristics or a combination of these characteristics, the waste is a federally regulated, "RCRA" waste.

In addition to understanding the federal lists of wastes, waste characteristics, and the exemptions, it is essential to having a working knowledge of the following concepts.

1. Mixtures of hazardous wastes and solid wastes.
2. Derived from hazardous wastes.
3. Hazardous wastes contained in environmental media or debris.
4. Used, reused, recycled or reclaimed hazardous wastes.

The "mixture rule". Under this EPA rule, a mixture of a listed hazardous waste (unless the mixture qualifies for an exemption see 40 CFR Part 261.3) with a solid waste, must also be considered a hazardous waste. For example, if an F listed waste was spilled onto the soil, the resultant mixture would be considered hazardous by the mixture rule. If a waste is hazardous solely because of a characteristic, (it is not on any of the lists) and it is mixed with another waste, the resultant mixture is only hazardous if the entire mixture continues to exhibit a hazardous characteristic. It is important to note that intentionally mixing wastes when not a normal part of production, for the sake of dilution, may be considered to be hazardous waste treatment requiring a RCRA permit.

The mixture rule is a controversial regulation. A recent law suit Shell Oil Co. v. EPA, 1991, has argued the mixture rule. In this case the court held that EPA did not provide adequate notice and opportunity for comment when promulgating these rules in l980.

2. Derived-from hazardous wastes. Under this rule a waste that is generated from the treatment, storage, or disposal of a hazardous waste (ash, leachate, or emission control dust) is also a hazardous waste. If this waste is derived from a listed hazardous waste, it is a hazardous waste. Like the mixture rule, if the derived from waste is from a characteristic waste (not listed) it is only hazardous if the resulting waste exhibits a hazardous characteristic.

3. The contained in rule, similar to the mixture rule, has recently been codified in 40 CFR Part 261.3(f). This rule states that any debris or media (soil, groundwater, surface water) contaminated with a listed waste is also considered a hazardous waste. The recent Federal Register 37194 has codified this rule, along with the corollary; that debris which is treated so that it no longer contains a listed hazardous waste will no longer be subject to RCRA Subtitle C.

Classification of Hazardous Materials According to D.O.T.

To determine if a particular material is regulated in transit as a hazardous material one must first evaluate the material to determine it's composition, either with a material safety data sheet, product information sheet, or if the material is a waste, by analytical data or generator knowledge. Armed with knowledge of the material being shipped, evaluation of the material in light of the Department of Transportation (DOT) regulations (CFR 49 Part 171) can be initiated to determine if the material is a DOT hazardous material.

DOT defines a hazardous material as "A substance or material, including a hazardous substance, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated."

The often difficult to interpret narrative definition of a DOT hazardous material is further defined as follows:

1. A material is a hazardous material when it is listed in appendix to 49 CFR Part 172.101, in the Hazardous Materials Table.
2. A material is a hazardous material in one package which equals or exceeds the reportable quantity (RQ) listed in the appendix to the Hazardous Materials Table for that particular material. A reportable quantity is the amount in pounds of a hazardous substance, as defined in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which when released to the environment requires notification of: the U.S. Coast Guard National Response Center (49 CFR Part 171.17).
3. A material is a hazardous material when; a component in the material (a mixture) of concern is listed in appendix to 172.10 at or above the concentration specified in the definition of a hazardous substance in Part 171.8 of 49 CFR.

These three criteria represent the starting point in determining if the material is regulated as a hazardous material. The operative key to determine if a particular substance is regulated as a hazardous material is the "proper shipping name". A proper shipping name is a technical name, generic name, or description of a hazardous material that is used in the Hazardous Materials Table of Part 172.101 of 49 CFR. Many times a particular material such as wastewater from floor wax stripping, although potentially a hazardous waste may not be listed specifically. When a specific material is not listed in the appendix, you must use knowledge of the composition of the material, MSDS's, and the appendix itself to obtain a "best fit" proper shipping name which most closely describes that particular material. Using the wastewater from floor stripping as the example, maybe the primary hazardous material in this waste is a petroleum distillate, the MSDS for the petroleum distillate having a flashpoint of 180 degrees F. If this waste had no other hazardous characteristics it would be given a proper shipping name of: combustible liquid n.o.s.(not otherwise specified).

It is essential to have a fairly accurate knowledge of the material's composition before a proper shipping name is assigned. Again, using the wastewater from floor stripper as an example, maybe a lighter petroleum fraction was a minor component in the wastewater, but if it floats on the waste product, and upon analysis “flashes off” at 100 degrees F, the waste would be improperly classified if described as a combustible waste. In this case where the flashpoint of a portion of the material is 100 degrees or less, the material is correctly characterized as flammable.

Given the correct proper shipping name, a hazardous material can than be packaged, labeled, and marked appropriately according to the appendix in 172.101 of CFR 49, the bible for hazardous materials handling.

Containers for Waste Transportation and Storage

Selecting an appropriate container for storage and transporting a hazardous waste is normally quite easy, but for certain materials it can be difficult. Usually if a waste must be managed in a container prior to shipping and disposal, the product container (the container which held the primary hazardous material), or package can be reused to dispose of the resultant waste (49 CFR Part 173.12; 49 CFR Part 173.28). Many hazardous material containers are "single use" packages and can only be reused for waste management if they, upon inspection, show no evidence of loss of integrity (49 CFR Part 173.28). Using an empty hazardous material container for waste management is a good option, especially if the supplier of the product will not accept these empties for return as a part of their services. If the product packaging can not be reused for the storage of a resultant hazardous waste, it is the waste generators responsibility to obtain the correct container (49 CFR Part 173.22 and Part 173.24.)

Given that the waste generator has characterized his waste completely, he/she now must consult the appendix in Part 172.101 to determine the packaging that is prescribed or permitted for the hazardous material. The proper shipping name will lead the waste generator to a column in the appendix which addresses specific packaging requirements for that particular waste, including the regulatory exceptions for that waste. In the case of corrosive wastes, for example, exceptions to the regulations may be provided, e.g. corrosives managed in volumes of less that 16 ounces. Specific packaging requirements will address compatibility directives and provide engineering specification codes for packages (such as fiberboard boxes, drums and tanks) appropriate for that particular hazardous waste or material.

With the knowledge of the waste composition and a listing of Department of Transportation codes for packaging appropriate to a particular waste stream, the waste generator usually has enough information to purchase the appropriate container. The specific information a generator must have to determine an appropriate container (packaging) includes the following:

1. Waste storage volume to be contained.
2. The specific gravity of the waste.
3. The DOT descriptive, and proper shipping name. It's also beneficial to know the major waste components and their hazardous constituents.
4. The approved DOT specification codes particular to your waste.

A comprehensive understanding of the waste is ideal when obtaining the appropriate container. Often times compatibility between the waste and the container are not the only storage issues which need to be considered. "In real (hazardous material) storage problems the technology of chemical compatibility goes far beyond hazardous chemical reactions of one reactive chemical with another." The following factors must also be considered (Huss l992):

1. Compatibility with secondary containment materials.
2. Compatibility with fire abatement methods.
3. Compatibility with human presence.

Additional information on container-waste compatibility can be from the container supply companies and engineering desk references. This research was capable of finding information only on hazardous product - container compatibility; nothing on waste material - container compatibility. Consequently if you are managing an unusual, or extremely hazardous waste, it is essential that the composition of the waste, along with the hazardous characteristics of the waste are understood before a DOT container is purchased.

At LLNL, for most wastes, container compatibility frequently boils down to one question. Is this waste more appropriate for a steel container or a polyethylene container? If the waste is primarily organic in nature (e.g. petroleum based) a steel container is used. If the waste is primarily a corrosive waste than it is stored in a polyethylene container. For solid hazardous wastes generated at LLNL, with no free liquids, nonbulk wastes are stored in open top steel containers lined with a plastic bag.

Hazardous Waste Sampling

SW-846 is the federal guidance document referenced in the California and Federal hazardous waste regulations used in determination if a waste is a hazardous waste or not. The determination of a waste as being "hazardous" is frequently determined by sampling the waste, followed by analysis. Proper sampling technique is essential for the accurate characterization of the waste (Fordham 1995).

The responsibility for determining the sampling strategy lies in the hands of the waste generator. In a case where a generator has a particular distinct parcel or volume of suspected hazardous waste, and is unsure of it's composition or disposal location it is probable that the waste requires sampling. In this case the generator of a waste such as wastewater from floor stripping operations would consult Chapter 9 of SW-846, Test Methods for Evaluating Solid Waste (Pilorin 1994).

There are four basic sampling strategies described in SW-846, each with particular advantages, and disadvantages.

1 Simple random sampling. Random sampling has a statistical meaning; it does not mean haphazard; it means that every part of a waste has a theoretically equal chance of being sampled. Random sampling entails detailed planning and painstaking implementation designed to eliminate the introduction of bias into the sampling results. Simple random sampling is the option of choice unless:

a) There are known distinct strata in the waste over time or in space.

b) One wants to prove or disprove that there are distinct time/or space strata in the waste of interest.

c) The number of samples being collected is being minimized, and you are trying to minimize the number of "hot spots" that could go un-sampled.

2. Stratified random sampling. This technique is used where a waste exhibits layering of materials, where contaminants are more often found in a given stratum. A sludge waste where the contaminants may settle out based on different densities may be well suited to sampling by this method. SW-846 states that this method is appropriate for wastes which are "nonrandomly heterogeneous in terms of its chemical properties and/or nonrandom chemical heterogeneity is known to exist from batch to batch."

3. Systematic random sampling. This sampling strategy involves the first sample of a specific population to be collected (statistically) on a random basis, but all subsequent samples to be taken at a fixed space or time interval. The advantage of this technique is the ease at which all of the samples are identified and collected. The disadvantages of systematic random sampling are the poor accuracy and precision that can occur when unrecognized trends occur in the population.

4. Authoritative sampling. Authoritative sampling is based on the knowledge of the sampler, without regard to randomization. The validity of the data is based on the sampler's knowledge and understanding of the waste, and how it was processed.

Industrial Wastewater Sampling

The sampling methodologies of an industrial wastewater, an aqueous waste which is discharged to the sanitary sewer system (with or without pretreatment) flowing to a wastewater treatment works) is completely different than sampling of a waste that is presumed to be unacceptable for discharge to a sanitary sewer system. If a liquid waste is unacceptable for discharge to the sewer where pretreatment is not an option, the waste must be containerized, or stored in a fixed location, and characterized via sampling and analysis prior to transportation and disposal to an off site facility. Industrial wastewaters on the other hand are sampled and subsequently analyzed (in most cases) after they have been discharged to the sewer line, and in transit to the Publicly Owned Treatment Works (POTW). This discharge is assumed to that meet the discharge limits established by the appropriate regulatory bodies (EPA 1992). Although hazardous wastes and industrial wastewaters are sampled under different situations, the goals of the sampling are the same. "To obtain "representative" data; that is, data which represents the nature and character of the discharge" [40 CFR 403.129(g) and (h)].

There are three basic strategies for sampling industrial wastewaters.

1. Grab sampling.
2. Composite sampling.
3. Continuos monitoring.

A grab sample provides a measurement of a pollutant concentration in the wastewater at a particular point in time. A grab sample might be used for a batch discharge which only occurs for a brief period, e.g., an hour or less (Cook l992). Composite samples are a series of grab samples which, taken together, measure the quality of the wastewater over a specified period of time (e.g. an operating day). Monitoring data maybe composited on either a flow or time basis. A <u>flow proportional composite</u> is collected after the passage of a defined volume of the discharge. A <u>time proportional composite</u> is collected after the passage of a defined period of time; every two hours for example. Continuos monitoring, although not true sampling, is a continuos quantification of wastewater parameters, used in determining environmental compliance. Wastewater temperature and pH are routinely measured continuously.

Compliance with effluent standards are most often determined on a "daily average, or monthly average" basis. Generally these wastewater samples should be collected using composite samples (Cook l992).
The term "daily maximum discharge limits" describe the actual numeric value set specifically for a site. These limits are designed to control the average wastewater strength over the course of the operating day. They are not intended to be instantaneous limits applied at any single point during that operating day.

The strategies for evaluating industrial wastewater permitted for discharge to the sanitary sewer system is much different than for obtaining a sample of a containerized waste where discharge to the sanitary sewer and ultimately the POTW is not anticipated. Containerized wastes are evaluated prior to disposal, and often times each container is analyzed individually via costly and time consuming laboratory analysis. Wastewater on the other hand, is discharged to the sewer before sampling and it is assumed that this wastewater sample will obtain an average concentration of the constituents over time.

Statistical Evaluation of Analytical Data for Waste Determination

Statistical evaluation of analytical data collected from samples is completed to better understand the average concentration of the waste sampled, and to evaluate the variation in concentrations (population distribution) of a particular contaminant in a waste. If the statistical evaluation of the waste is to provide useful information, the statistical evaluation should be carefully designed, and applied using scientific principles. These statistical studies should be cost effective, and the data statistically analyzed so that the maximum amount of information is extracted (Gilbert l987).

One problem is how to define the environmental "population of interest". Unless the population is clearly defined and related to the study objectives and field sampling procedures, the collected data may contain very little useful information for the purpose at hand.

It is also essential that the study objectives be clearly defined before the data is collected. The study objectives in the case of waste sampling maybe to determine whether a waste is hazardous or not. The regulatory thresholds that effect the waste of concern must be understood. The accuracy and precision of the data analysis must also be established at this time, to meet the objectives of the study. Evaluation of a complex waste-stream may involve the following professionals: an end user of the data, an experienced waste sampler, an analytical chemist, an engineer familiar with the waste generation process, a statistician, and a quality assurance representative (SW-846 l986).

Assuming that the sampling of the waste was representative, the data analyst must be aware that many statistical procedures are designed for data presumed to have been drawn from a population having a symmetric, bell shaped, or "normal" distribution.

However, environmental data sets are frequently asymmetrical and skewed to the right, towards higher concentrations; consequently classical statistical evaluations of the data may not be valid (Gilbert l987). A variety of asymmetrical distributions of data can be evaluated appropriately by determining a "best fit" by "transforming" the data to other forms of data patterns. Environmental data which may be skewed to the right may be more appropriately evaluated using lognormal distribution, square-root transformation; or an arcsine transformation.

Once the data is evaluated and a best fit can be found with a distribution of the population, the data can be transformed, and be evaluated in the same manner as data which has a normal distribution.

Environmental data (analytical data from waste evaluation) can have several other problems:

1. Large measurement errors at or near measurement detection levels.
2. Missing data values.
3. Suspect data values.
4. Correlated data. Data which is not representative of the average waste for a specific reason.
5 Complex trends and patterns in mean concentration levels over time and or space.

These common problems can seriously affect statistical tests and can give misleading results when estimating the variance of estimated means, computing confidence levels or determining the number of samples needed to estimate a mean value.

In evaluation of a waste to determine whether the waste is hazardous or not, the "upper confidence level" must be compared to the appropriate regulatory thresholds as described in SW 846. "For the purposes of evaluating solid wastes, the probability level (confidence interval) of 80% has been selected. That is, for each chemical contaminant of concern, a confidence interval (CI) is described within which the true mean occurs if the sample is representative, which is expected in about 80 out of 100 samples. The upper limit of the 80% CI is then compared with the appropriate regulatory threshold. If the upper limit is less than the threshold, the chemical contaminant is not considered to be present in the waste at a hazardous level; otherwise, the opposite conclusion is drawn. One last point merits explanation. Even if the upper limit of an estimated 80% CI is only slightly less than the regulatory threshold (the worst case of chemical contamination that would be judged acceptable), there is only a 10% (not 20%) chance that the threshold is equaled or exceeded. That is because values of a normally distributed contaminant that are outside the limits of an 80% CI are equally distributed between the left (lower) and right (upper) tails of the normal curve. Consequently, the CI employed to evaluate solid wastes is, for all practical purposes, a 90% interval (SW-846 l986).

In the statistical evaluation of wastewaters, to establish precision and accuracy the 95% confidence interval is utilized.(Standard Methods For The Examination Of Wastewater 1975). This 95% confidence level is then applied to a data set of analyses with the assumption that this data fits the normal curve. Data transformations are not discussed. Within this guidance document, numerical values (t values) have been established which will allow the application of traditional statistics to small numbers of samples: 2,3,4,5 and 10 samples. This allowance is important because of the cost, and time required, for the sampling and analysis of wastewater.

California incorporates the statistical evaluation of waste according to SW-846 in Title 22, section 66260.200 for waste generators wishing to obtain concurrence from the Department of Toxic Substance Control in a "non-hazardous waste determination".
For waste generators having a large waste stream which is potentially hazardous, but is generally classified and managed as a non-hazardous waste, it is advisable to obtain Departmental concurrence from the Department of Toxic Substance Control because of the

liability, and potential regulatory violations involved in managing a hazardous waste as non-hazardous.

The validation of analytical data is an additional factor which is key to its application in waste classification. The statistical evaluation of the data set is used in determining if the entire data set can be used in characterization of the waste as a wastestream. There are a variety of tests which can be used to chart and detect "outliers", and/or uncorrelated data. Often times a computer analysis of the data sets can be effectively used in validation of the data.

Many facilities have routine monitoring programs which generate very large data bases. In this situation it is important to develop efficient computer storage, retrieval, and data analysis, and graphical software systems so that the data can be fully utilized. The development of interactive graphics terminals, minicomputer, and personal computers greatly increases the potential for the investigator to view, plot, and statistically analyze data (Gilbert l987).

Recent Case Law Involving Hazardous Waste Classification

The federal and state regulations on hazardous waste determination are quite complex. This research will summarize a few of the most recent cases which involve judgments relating to hazardous waste classification.

Perhaps the most important Court decision on the Federal level regarding waste classification is the Shell Oil Co. v. EPA, 950 F.2d 741 (D.C. Cir. 1991). This case addresses the "mixture rule" and "derived from rule" discussed earlier. The court held that EPA did not provide adequate notice and opportunity for comment when promulgating these rules in l980. At the court's suggestion, however, EPA then re-promulgated the mixture and derived from rules on an interim basis. 57 Fed. Reg. 7628 (March 3, l992).

Congress has now directed EPA to promulgate revisions to these rules, if necessary, by October 1, l994. Pub. L. No. l02-389 (Arbuckle l993).

West's 1992 Annotated California Health and Safety Code references two specific cases at the appellate level addressing waste classification: Liquid Chemical Cor. v. Department of Health Services 227 Cal. App.3d 1682; 279 Cal. Rptr. 103 [Jan. 1991]; and People v. Martin, Court of Appeal [June l989].

Liquid Chemical Corporation located in Hanford CA, is a fertilizer company. This Company is operated by Donald Garret, who has a Doctorate in Chemical Engineering. Since l985 Liquid Chemical Corp. purchased "sal skimmings", "galvanizer's ash", "ball mill fines", "filter cake", "zinc hydroxide" and "zinc baghouse flue dust" to use as raw materials in the production of fertilizers. Regarding waste classification the Court had to evaluate several issues.

1. Were any of these materials, e.g. "sal skimmings", hazardous waste by either California or Federal law.

2. If any of these materials were hazardous wastes, did these materials meet any of the exemptions which would preclude their management of hazardous waste?

3. Was the regulatory definition of a waste to vague for the average person to interpret?

In response to question one overwhelming evidence was presented by the sellers of ball mill fines, filter cake, zinc baghouse flue dust and galvanizer's ash and Mr. Garret himself that these materials were indeed hazardous waste. As an example of the evidence, a Mr. Short of Anchor Post Products who had sold galvanizers ash to Liquid Chemical Corp. (LCC) testified that prior to selling this material to LCC, he had his employees haul the material to the dump. Garret of LCC admitted that galvanizer's ash was at least 70% zinc particulate, and exceeded the .5 percent level (5000 mg/kg when evaluated using the TTLC analysis) set by the state regulations to render the material hazardous.

Regarding exemptions to hazardous waste regulations, the court found none available to Liquid Chemical Corporation. "...overriding any potential exemption is the language found in Health and Safety Code Section 25143.2 subdivision (e), which provides in relevant part. "All of the following recyclable materials are subject to the requirements of this chapter which apply to hazardous waste. (1) Any material used in a manner constituting disposal of the material, or any material used to produce a product that is applied to the land as a fertilizer, soil amendment, agricultural mineral, or an auxiliary soil and plant substance. Since LCC's entire business operation was the production of agricultural fertilizer this fact alone overrides any claim of exemption" (Liquid Chemical Corp. v. DHS).

Speaking to the clarity of the regulatory definition of hazardous waste, the court relied on the People v. Martin (described below) case on finding the regulations both constitutionally valid and clear.

Liquid Chemical and Garret himself were both found guilty of storing, treating and disposing of hazardous waste without a permit; for this regulatory violation, along with nine other violations. Liquid Chemical Corporation and Dr. Garret were each fined civilly $250,000.

People v. Martin (l989) a criminal case in California found Mr. Martin criminally liable for "knowingly disposing of hazardous waste, or knowingly causing others to dispose of hazardous waste", at the Chem-O-lene plant in violation of Health and Safety Code section 25189.5. This criminal prosecution was based on Martin's actions in l985 where Martin directed employees at Chem-O-Lene to truck 182 "empty hazardous material" barrels from Chem-O-Lene to the Unico facility. At Unico, a number of these barrels were smashed, causing their liquid contents to spill to the ground.

Mr. Martin's defense of his actions in this criminal case were founded on the following premises related to the classification of hazardous waste.

1. The California hazardous waste laws are "unconstitutionally vague" with regard to its definition of hazardous waste.

2. The "empty" 55 gallon drums were exempt from hazardous waste regulation because they are "recyclable hazardous waste".

3. The empty drums are a waste which is "insignificant or unimportant as a potential hazard to human health".

Regarding Martin's claim that the California hazardous waste regulations are unconstitutionally vague, the court disagreed by referencing Hoffman Estates v. Flipside. This case included statements by the judge stating "These statutory definitions for those who produce or handle hazardous waste provide adequate notice and adequate standards for enforcement for those who police such businesses. Regulated businesses can be expected to consult relevant legislation in advance of action and may have the ability to clarify the meaning of the regulation by its own inquiry, or by resort to an administrative process". Judge Gilbert in writing his decision says: "Further, the regulations promulgated by the Department of Health Services pursuant to the code contain a list of hundreds of materials designated potentially hazardous, and include mathematical formulas and scientific standards by which hazardous wastes are identified. Even though statutes need not be of mathematical certainty, these are."

In addressing the issue of the empty hazardous materials drums, the court references California Health and Safety Code Section 25124. In pertinent part this section defines "hazardous waste as... any recyclable material". The regulations, in turn, contain a list of Recyclable Hazardous Waste Types, which include unrinsed empty containers of iron or steel used for hazardous chemicals. Martin stated during this case that he tried to sell these drums to a recycler. The court ruled that this action in itself was sufficient to charge Martin with knowledge that the barrels were subject to regulation as a hazardous waste.

Martin's claim that empty 55 gallon drums were insignificant or unimportant as a potential hazard to human health (thereby not regulated as a hazardous waste) was flawed by his lack of pursuit of a regulatory variance. Title 22 Section 66310 provides for procedures for obtaining a variance from hazardous waste regulations "where the waste is insignificant as a potential hazard to human health or wildlife because of its concentration, or physical or chemical characteristics". There was no evidence provided that Martin applied for, or received a variance, and the jury could properly conclude that the drums at issue were regulated as a hazardous waste under California law.

For Martin's role in directing the transportation and crushing of the "empty" hazardous materials barrels, he was criminally convicted on two felony counts of transporting and disposing of hazardous waste. The court sentenced Martin to five years of felony probation with fines and penalties totaling $127,500.

Case law in California in People v. Martin and Department of Health Services v. Liquid Chemical Corporation has established precedent that the laws and regulations regarding waste classification are valid, and will be enforced strictly where appropriate. These two cases send the clear message to the waste generator that if a potential hazardous waste is to be managed as anything but hazardous waste that they must have reason to do so based on established regulation and scientific standards.

<u>Case Study: Kaiser Medical Offices, Petaluma California</u>

The Kaiser Medical Offices located at 3900 Lakeville Highway Petaluma, CA were found to have zinc concentrations in their wastewater that exceeded their permit issued by the City of Petaluma beginning in July of 1992. These elevated zinc concentrations are based on samples taken based on their Industrial (water) User Permit No. 0610 issued by the City of Petaluma. This wastewater discharge permit requires daily composite sampling of their effluent. Kaiser's discharge limits for zinc are: daily maximum average: 1 mg/l, monthly average: 1 mg/l. During the Summer and Fall of 1992, their discharge sampling found the following sampling events where zinc concentrations exceeded their discharge requirements to the Petaluma Wastewater Treatment Plant (WWTP):

Table 2.1. Zinc Excursions: Kaiser Medical Offices, Petaluma, CA

Sample Date	Zinc Content
June 16, 1992	140.0 mg//l
July 29, 1992	16.4 mg/l
Oct. 27, 1992	8.5 mg/l
Nov. 3, 1992	13.0 mg/l

The first letter that was sent to Kaiser regarding their wastewater discharge violation which involved the zinc concentration was July 17, 1992. This letter was sent by Martin Swift of the Petaluma WWTP.

This research determined in personal interview with Mr. Swift that it wasn't initially known what the source of the zinc was in their wastewater. Mr. Swift informed the author that Kaiser eventually tracked down the source of the zinc to floor finish removal operations.

The type of automated sampling equipment in combination with the floor finish removal schedule combined to generate an extraordinarily high concentration from the June 16 1992 sample: 140 mg/l! According to Swift, floor finish removal operations at the Kaiser Facility occurred on Fridays, after business hours (Kaiser did not reopen this facility until Monday morning). Kaiser had installed a "time proportional" sampling device, which every hour would take a grab sample of the wastewater in a designated spot in a manhole. Consequently after the floors were stripped on Friday night, and this wastewater was discharged to the sanitary sewer system, this wastewater was retained in the sewer accessed by this manhole for the remainder of the weekend until it was flushed out during business hours on Monday. The timed sampling device re-sampled this "trapped" wastewater throughout the weekend providing the high "average discharge concentration" for zinc of 140 mg/l. If a flow (volume) proportional wastewater sampler had been installed into Kaiser's discharge lines, it remains questionable whether they truly exceeded either their daily, or monthly average discharge concentration of 1 mg/l for zinc.

On March 22, 1993 Rogers And Associates issued an environmental report to the Petaluma WWTP which included abatement methods for the zinc contained in Kaiser's wastewater. The executive summary included in this report discussed the problem of zinc in Kaiser's wastewater.

"ZINC(Zn) PROBLEM SOURCE: The source of Zn was determined to be from floor stripping process in 1992.
CORRECTIVE ACTION: The next scheduled floor refinishing contract will require that all stripped floor liquid and material be collected and discharged as Hazardous waste.
Future floor refinishing materials will be selected that do no use zinc or any other metal interlock that is not approved for discharge to the sanitary waste system.
Should this type of product not be available, each subsequent refinishing project will require that all stripped floor liquid and material be collected and discharged as Hazardous waste."

The fact that Kaiser volunteered to manage this waste as a hazardous waste because it was not sewerable indicates that the determination of the waste as non-hazardous was more time consuming, and costly than assuming it was hazardous.

On May 12, 1993 an interoffice memo was issued by Patricia Burkett (the Kaiser Haz/Mat Compliance Facilities Engineer) to the regional managers for Kaiser Permanente in the Northern California region requesting them to evaluate floor sealers and finishes in light of their zinc content.

Ms. Burkett requested that regional managers review MSDS sheets for floor finishing, and to choose an alternative non-zinc floor finish throughout the region that she has jurisdiction over.

Another fact worth noting in the Rogers And Associates Report from March 1993, was the inclusion of the Material Safety Data Sheets for the wax and sealer products which were used during the period when the floor finish removal wastewater exceeded the wastewater discharge standards. The wax used was Ultra Hi Base Coat and the sealer was Acrathane Resilient Floor Sealer, both of which are distributed by the National Sanitary Supply Company. The material safety data sheets for both of these products omitted the zinc constituent in their list of ingredients in section 2. Although the inclusion of zinc in this section is not required, MSDS's which have a more comprehensive listing of the chemicals is much more valuable to the user of the product.

What is also noteworthy in the Kaiser case study is the very low discharge requirement of 1 mg/l assigned by the Petaluma WWTP. In questioning Mr. Swift about this he stated that these levels were dependent on their permit requirements issued to them from the Regional Water Quality Control Board (RWQCB). The RWQCB had issued stringent permit requirements to the City of Petaluma based upon the condition, and quality of their treatment works (this treatment works was built in 1932), and on their effluent discharge which enters the Petaluma River, which flows into the biologically sensitive San Francisco Bay only 15 miles downstream.

The Kaiser Facility also has a permit requirement issued by the City of Petaluma regulating fats, wax, grease or oils of petroleum origin which may be impacted by the discharge of wastewater from floor finish removal. Petaluma will allow Kaiser to discharge these petroleum oils and waxes in concentrations of less than 100 mg/l. Water based waxes contain acrylic polymers, and resins, when analyzed for oil, which uses a freon extraction method, will pick up the acrylic wax as if it were oil in concentrations exceeding 800 mg/l (see appendix C).

For oil, grease and fat discharges, industrial users of water in Petaluma (section 15.48.110 of Petaluma Ordinance 1827), are required to install interceptors and grease traps. These removal devices must be installed when they are "necessary for the proper handling of liquid wastes containing grease or oil, sand or other harmful ingredients."

These interceptors seem to be a potential option for the interception of the sludge bearing wastewater from floor stripping.

In summary, the Kaiser Facility is the best case study on the management of wastewater from floor finish removal available. Kaiser made the decision to alter their floor care product from a zinc containing finish to a non-zinc finish to effectively eliminate the zinc in the wastewater. Another option would have been to purchase a flow proportional sampling device, which would provide a much more accurate average discharge of zinc per unit volume of wastewater. It is quite conceivable that by using a flow proportional sampling technique that the zinc concentration would drop below the average discharge concentration of 1 mg/l. Another option would be to alter the floor maintenance program with the goal of minimizing floor finish stripping operations. The floor care program could increase the wet mopping of the floor with water, and increase the routine floor cleanings involving the use of a light detergent. These practices are designed to take better care of the floor and reduce the floor finish stripping process to perhaps once each year. Perhaps the stripping operation could take place before business hours during a very busy day, which would have the effect of reducing the average concentration of the zinc in the wastewater. Another alternative if available would be to discharge the wastewater from the finish removal operation to an oil - sand separator system, where the zinc laden sludge could settle out before entering the sewer system.

CHAPTER 3

RESEARCH DESIGN

Both primary and secondary data will be utilized in classifying wastewater from floor finishing as hazardous or not; and in the evaluation of the best storage container for this waste while on the Lawrence Livermore Laboratory Site.

Research Subproblem One: Statistical Waste Classification

The data used in the first subproblem, the statistical (hazardous waste) classification of wastewater from floor finish removal comes from the primary source, waste analysis via the LLNL Environmental Analytical Sciences (EAS) Group. This analytical data comes from samples, and the subsequent laboratory analysis of wastewater from floor finish removal operations at LLNL. Specifically this wastewater is from non RMMA areas, which has been collected and stored in 55 gallon drums. This primary data once compiled is composed of all wastewater analysis from floor finish removal operations that has been stored, and analyzed from 55 gallon drums.

The criteria used for the acceptance of this data is specific.

1. The data used in the statistical analysis of wastewater must originate from analysis of wastewater generated by the custodial crew working at LLNL.
2. This LLNL wastewater from floor finish removal must originate in areas where radioactive materials are not openly managed.
3. All samples of the wastewater must be taken using a COLIWASA sampling device. COLIWASA is the acronym for "columnar liquid waste sampler".
4. All analytical data derived from samples taken from 55 gallon drums of wastewater from floor finish removal operations, using a COLIWASA, must be analyzed by an analytical laboratory certified by the state of California.

5. Zinc, lead and pH data will be used because they represent the only constituents or characteristics (of the wastewater) which at any time exceeded the regulatory thresholds for hazardous waste.

Copies of all analytical data meeting this criteria will then be obtained from either the LLNL Hazardous Materials Archives, or from the Environmental Analytical Science office on the LLNL site. This data will then be compiled on an Excel spreadsheet where this information will then be summarized in tables or histograms and exported to the comprehensive statistical software package: S-Plus version 3.2 where the information will be graphically analyzed and evaluated in light of the SW-846 protocol for hazardous waste determination. This methodology in Chapter 9 of SW-846 is referred to as the: "STRATEGY FOR DETERMINING IF CHEMICAL CONTAMINANTS OF SOLID WASTES ARE PRESENT AT HAZARDOUS LEVELS, General Procedures". See appendix E.

Statistical Data Tables

The data for each individual metal and pH analysis will be laid out in two tables: the data table, and the statistics table. The first table, the "data table" will include a summary of the data for the specific analyte of concern. See Table 4.2 as an example. The data table headings include the following:

Sample #: The sample number is the number assigned to a particular analysis by the LLNL Environmental Analytical Sciences Group. An example number is 9201926. The first two digits represent the year (92), the following digits represents the current number of samples logged in by EAS in that particular year.

Date: The date the sample was taken. It is important to understand that the "date" represents the day the sample was taken, not the day that the waste was generated.

TTLC metal: Is the quantity of zinc, or lead in mg/kg found in a specific sample. TTLC analysis is commonly referred to as the "total metal" concentration.

STLC metal: Is the quantity of the metal in mg/l found in a specific sample analyzed by the WET method. The STLC metal is referred to as the "soluble fraction" of the total amount of the specific metal in the sample and can generally be considered the amount of metal which is leached from the waste matrix, after exposure to a dilute acid having a pH of ~ 5.0 for a 48 hour period. For an aqueous waste such as wastewater from floor finish removal, this leaching procedure is conducted on the solid fraction of the waste. This contaminant concentration of the leachate is then added to the contaminant concentration (of the same metal) found in the liquid fraction to obtain the STLC concentration.

The STLC ratio: This research generates artificial STLC values from TTLC values. The highest ratio of STLC value to TTLC value is used to estimate a conservative STLC value for a particular container where none exists. For example, from Table 4.2 the highest ratio for STLC zinc to TTLC zinc is from sample 9202995. The soluble ratio is 520 ppm to 940 ppm, or 56% of the zinc in this sample is soluble. Where STLC data is not available for a particular sample, a TTLC value is multiplied by 56% (0.56) to generate a corresponding STLC value. These generated STLC ratio's are then combined with the other samples that were analyzed by the STLC method, and evaluated as one data set. This approach develops a more statistically valid STLC concentration according to MacQueen (1994) which then can be evaluated, and compared to the STLC regulatory threshold.

The second table, the statistics table provides the statistical evaluations of zinc, lead and pH data summarized in the data table. The headings of the statistics table are explained as follows:

Across the top of the statistics table are four columns, one each for the different data forms: Untrans, for the untransformed data; Arcsine for the arcsine transformation of the data; Sq. Root for the square root transformation of the data; and Log for the log normal transformation of the data.

Untransformed data (raw data): This primary analytical data is expressed in the original units - parts per million (ppm). If this data is statistically evaluated it is assumed to have a normal distribution with the characteristic bell shaped curve. In a normal distribution the data is spread equally above and below the mean, with a corresponding decrease in frequency of values as you move away from the mean in a positive, or negative direction. According to SW-846 the data should not be transformed when the mean is approximately equal to the variance.

Arcsine transformation: Is used for data that is proportionally distributed. According to SW-846 the arcsine transformation should be used when the mean is less than the variance. When completing the arcsine transformation, it is essential that the unit of measure be radians, not degrees.

Square Root transformation: Should be used when the data has a slight positive skewness. According to SW-846, the square root transformation should be used when the mean concentration is less than the variance.

Log transformation: Is used when the data has a positive skewness. It is important to note that according to Helsel and Hirsch (1992) that "The most commonly-used transformation in water resources is the logarithm".

Along the left side of the statistics table are the three methods (in bold print) that this research has chosen to view the metals data: TTLC (total threshold limit concentration); STLC #1 Hybrid; and the STLC #2 Ratio. For the pH data the different STLC - TTLC databases are not appropriate.

TTLC: This database represents all of the TTLC (total metal concentration) analysis described in the third column of the metals data table.

STLC#1 (Hybrid): Is the name that this research applies to the set of data of a particular metal analyte which includes the STLC analysis when it is available and the TTLC data wherever the STLC analysis was not completed. This combination of TTLC and STLC data is then evaluated as one data set, and statistically evaluated and compared to the STLC regulatory threshold.

STLC#2 (Ratio): As described for the data tables, is the data set composed of the STLC analysis in combination with a derived STLC value (for a sample from a container) where the STLC analysis was not completed. This “generated” STLC value is based on the highest ratio of a STLC concentration to a TTLC concentration in a particular metals database, e.g. zinc.

For each of these four data formations, and data sets of TTLC and STLC analysis the following statistics where generated in order to evaluate the waste in relationship to the SW-846 protocol for determining if the waste is hazardous:

Mean (x): The average concentration of the waste constituent.

std. dev. (Standard deviation): A measure of the extent to which individual sample concentrations are dispersed around the mean.

Variance (s^2): A measure of the squared dispersion of observed values, expressed as a function of the sum of the squared deviations from the population mean.

SW846CV: (SW-846 Coefficient of variation): Is the variance (s^2) divided by the mean. This coefficient of variance is what is used to determine if a data set is normally distributed, or requires transformation before it can be statistically evaluated.

Coef vr 2 (Coefficient of variation) Standard deviation (s) divided by the mean (x). This ratio of the standard deviation to the mean is used in describing the amount of variation in a population.

UCL (Upper confidence interval): SW-846 uses the 90% confidence interval as the UCL where the upper bound of the population distribution is the only concern. An estimated

10% of the sample population is expected to be found in this range. For a two tailed distribution, such as pH where the upper and lower bounds of the distribution are both relevant for waste classification, an 80% confidence interval is utilized. The UCL represents a calculated 10% upper bound of the population, and the lower confidence interval (LCI) represents the theoretical concentration range below which the lower 10% of the sample population is estimated to fall with in.

t-hold (Regulatory Threshold or RT): Is the concentration of any particular analyte which will make a waste hazardous at a given concentration. In the case of wastewater from floor stripping, each analyte has two theoretical regulatory thresholds. All of the metals have an STLC threshold for their soluble fraction, and a TTLC threshold for the total concentration of metals in the mixture. A key in understanding these tables is in understanding that in this research both the STLC and TTLC concentrations, are compared to the STLC threshold. This comparison of the hybrid data generates an extremely health protective value of the contaminant where only the STLC threshold is utilized. This practice is utilized because none of the metal concentrations ever come close to the TTLC RT. The pH of wastewater from floor finish removal, like the metals analysis, also has two regulatory thresholds; an upper RT of 12.5, and a lower threshold of 2.0. The lower pH RT of 2.0 will not be considered in this research.

Calculated "n": Is the appropriate number of samples calculated for a specific data base with a given population distribution. This number is determined from the students t test, the variance, and the regulatory threshold. The calculation for the appropriate number of samples can be found as equation 8 in the SW-846 protocol. See appendix D.

Decision: This is the comparison of the 90% confidence interval (as required in SW-846) to the appropriate regulatory threshold. Where the regulatory threshold is greater than the 90% confidence level, the waste is non-hazardous.

The data illustrated in these statistical table will then be used in conjunction with the different probability plots (graphs) of the contaminant concentrations plotted against the normal distribution fit and the regulatory threshold in order to determine which data transformation is best applied to determine if this particular analyte should be considered hazardous.

Probability Plots

These graphs will be generated to more easily interpret analytical data of this waste in order to visualize if this wastewater is hazardous or not using the available data. The elements of the graph include the following:

The Title: This descriptive title describes the analyte evaluated, and the type of data used in interpreting that analyte's concentration. The title for the graphs of the pH data is "pH". Three different data interpretations are completed for each metal analyte using each of the four data expressions: raw, arcsine transformation, square root transformation, and log transformation. This metals data is then interpreted using the TTLC database, STLC database and the STLC ratio database as described earlier.

Lines on the graph. Three lines are represented on each graph, they represent the following:

1. A continuous line (——) is used to connect the data points of various concentrations of a specific analyte. This line can be thought of as representing the "sample population" for that particular analyte.

2. A dashed line (----) is used to describe the soluble regulatory threshold for the metals, and the 12.5 pH value when evaluating corrosivity. Where (STLC) data points are above this line, it represents a sample of a particular analyte from a drum where the waste concentration is hazardous. Likewise, if the data is below the line, it is non-hazardous.

3. A dotted line (····) is used to describe the normal distribution fit as determined by the robust method on the S-PLUS software package. The closer the sample population line

matches the normal distribution line, the better traditional statistics can evaluate the database. Where the continuous data point line does not match the normal distribution fit line as well, statistical evaluation of the data to obtain confidence intervals and other statistical interpretations are not as valid.

The soluble threshold analysis (STLC) for a metal analyte is represented by small black diamond. Each data point represents one analysis performed on one drum of waste. In each graph there will be 18 data points, each representing an analysis from one drum. The total metal concentration (TTLC), or converted TTLC value is represented by the plus sign, +.

The y axis represents the concentration of the analyte in ppm or the transformed concentration of the analyte, as determined by the data transformation under consideration. The x axis illustrates the "expected number of standard deviations from the mean".
90% UCL: This notation represented by a tick mark (-) along the right hand margin of the graph represents the numerical value for the 90% confidence interval as determined by the SW-846 methodology. Wherever the 90% confidence interval is below the regulatory threshold line the analyte via that particular interpretation is not hazardous.

Together the statistical information from the data tables, statistics tables and probability plots will be summarized in the statistical interpretive chart.

Histograms

Histograms of the different data transformations of the hybrid data for zinc will be drawn to provide an additional tool to evaluate the distribution of the data. The x axis will describe the concentration of the contaminant or the transformed concentration of the contaminant. The y axis illustrates the number drums. The histogram, with the use of bins, or bars will show how the analytical data of the wastewater drums is distributed.

Where the tops of the bins, connected by a line, form a bell shaped curve (assuming the histogram is drawn correctly) the data is normally distributed, and can be evaluated accurately with the statistics. Where a particular transformation is evaluated using a histogram, and the data is abnormally distributed, an alternate data transformation should be considered.

Hazardous Waste Determination: Interpretive Chart

This chart has been designed to evaluate several characteristics of the analytical data with the main focus being the accurate classification of the waste, at LLNL, based specifically on the analyte of concern. The categories used for evaluation of each data set, (including their transformations) under the TTLC, STLC Hybrid and STLC Ratio headings are:

Distribution Fit: The distribution fit is determined subjectively based on visual observation of the data pattern on the graph, and it's comparison to the normal distribution fit line also on the graph. The closer the match between the line drawn between the data points and the normal distribution fit line the better the grade (Excellent, very good, good, average, below average, poor).

90% CI: The 90% confidence level determined by the SW-846 method. Where the 90% confidence level is less than the appropriate regulatory threshold, the waste is considered to be non-hazardous.

Reg. T.hold (RT): The appropriate regulatory threshold. Where the 90% confidence interval equals or exceeds this value, the waste is considered to be a hazardous (toxic) waste

90% CI/R.T.: This ratio used in this research is designed to provide a relative value for the degree of toxicity for the waste when the data is evaluated with different statistical transformations.

Hazardous Determination: This is the result of the comparison of the 90% confidence interval and the RT. Where the RT exceeds the 90% CI, the waste is not hazardous and the response would be "no".

Validity, Application: This is a number subjectively assigned based on the statistical validity of the transformation and the importance of application in the classification of this transformation in determining if the waste is hazardous or not at LLNL. Where the raw data is evaluated (assuming a normal distribution), five points are automatically given because no data transformation is required.

Research Subproblem Two: Waste Toxicity Determination

The data obtained for this subproblem is designed to answer the question: is wastewater from floor finish removal operations at LLNL, hazardous waste for toxicity by any method other than statistical evaluation? The actual data used for the these toxicity determinations include: the historical analytical data based used in the statistical evaluation (subproblem one) in addition to material safety data sheets, generator knowledge and (industry) consensus toxicity values. The guideline used in this toxicity determination comes directly from Title 22 CCR 66261.24. Consequently, the data acquired will evaluate:

1. Acute oral toxicity.
2. Acute dermal toxicity.
3. Acute inhalation toxicity.
4 Acute aquatic toxicity.
5 Chronic toxicity.

The evaluation of the oral toxicity, dermal toxicity and to some extent inhalation toxicity will evaluate the cumulative toxicity of the waste components as described in Section 66261.24(c).

The key data in evaluating the cumulative toxicity of wastewater from floor finish removal can roughly be divided into two categories: generator knowledge, and toxicological reference data.

Joe Brown, Custodial Supervisor at LLNL will provide the process knowledge of: what is applied to the floor, how much material is applied to the floor, and how much waste is removed from the floor

The products used in this research based on information from Mr. Brown include: Buckeye Mainstream: non-zinc, acrylic, water based floor finish (wax); Buckeye First Down, non-zinc, acrylic, water based floor sealer; Buckeye Straight Up, a pH neutral floor cleaner, and Buckeye Revelation, aminiacal floor finish (stripper) remover. The hazardous ingredients evaluated in this toxicological research will be obtained from the material safety data sheets for each one of these products described.

In determining how much material was applied to the floor and removed from the floor Mr. Brown will use a basis of 5000 square feet of floor surface.

Table 3.1. Process Knowledge: Toxic Ingredient Origin

	Mainstream	First Down	Straight Up	Revelation	Wastewater
Quantity used, or waste generated	4 gallons per 1 coat of finish.	4 gallons per 1 coat of sealer	16 ounces	16 ounces	16 gallons

Using this information from Brown's experience this research will make several assumptions in order to determine the quantity of toxic ingredients generated for every 5000 square feet of flooring or 16 gallons of wastewater. These assumptions are:

1. The ratio of floor scrubbing operations to floor finish removal operations is: 3 to 1.
2. Each floor scrubbing job includes the application of 16 ounces of Straight Up; which will remove exactly one coat of Mainstream floor wax.

3. Each floor finish removal operation will include 16 ounces of Revelation, which will remove exactly one coat of Mainstream Floor Finish and one coat of the floor sealer, First Down.

4. All floor sealer and wax initially applied to the floor will remain on the floor until they are removed during a scrubbing or finish removal operation.

5. All of the cleaning solvents applied to the floor will be picked up and collected in the wastewater, along with all of the floor wax and floor sealer.

Given the above assumptions and the quantities of initial ingredients from the MSDS's, the weight percent of each chemical constituent will then be applied to determine the concentrations of these constituents in the wastewater.

Toxicity Databases:

These databases are designed to illustrate and compile data on cumulative acute toxicity's, either dermal, ingestion or inhalation based on the material safety data sheet information used in combination with generator knowledge (material application, along with floor cleaning, and stripping protocols) and toxicological references, primarily *Sax's Dangerous Properties of Industrial Chemicals, Eighth Edition* and the historical analytical data used in the statistical evaluation. The constituents must be listed on the product material safety data sheet or in an analytical sample result in order to be included in the toxicity evaluation.

The toxicity databases will be used to incorporate the information from historical analytical data, generator knowledge, and the material safety data sheets from the floor care products, and apply it to Title 22 section 66261.24(c) which allows for the calculation of a cumulative toxicity which can be compared to a dermal or inhalation toxicity threshold. The data in the toxicity interpretive charts will utilize the following categories:

The Primary Constituents: This heading refers to the chemicals listed on the material safety data sheet for that specific product (underlined), for which toxicological reference data could reasonably be found. If a constituent was listed as a hazardous material on the MSDS sheet but toxicity data could not be found, this material was not evaluated in the cumulative toxicity determination.

Chemical in Product: Refers to the weight percent of the hazardous ingredient as provided in section two of the material safety data sheet. This information will also be expressed in parts per million (ppm).

Chemical in Waste: This information will be obtained from the MSDS material concentration combined with (generator knowledge) how frequently each product is used, how much is applied, and how much waste is generated for each 5000 square foot section of flooring that has been cleaned.

Dermal Toxicity, Ingestion Toxicity or Inhalation Toxicity: This column will be used to illustrate two types of information: The bold yes or no responses refers to the MSDS section on routes of entry. If "skin" is noted under the "route of entry" section on the MSDS, "yes" is the response on the interpretive chart. A yes response indicates potential dermal or inhalation hazards are present in this particular product. For the ingestion interpretive chart, the actual LD_{50} for the pure product will be listed. The other type of information found in this column will be the appropriate LD_{50} for that particular compound in mg/kg. This toxicity data will be obtained from *Sax's Dangerous Properties of Industrial Chemicals, 8th Edition*. When a particular compound is looked up in Sax, the exact LD_{50} requested for evaluation as a hazardous waste may not be found. If toxicity data from a similar test on a different animal has generated an 8 hour (dermal toxicity for example) toxicity result which is published in Sax, this data will be used in the evaluation. Likewise if the exact chemical cannot be found in Sax, a similar chemical maybe substituted where there is toxicity data, if reference data indicates that this toxicity data is equally or more toxic than the material in the wastewater.

Weight % divided by LD_{50}: This number will be derived when the weight percent of a particular contaminant in the waste is divided by it's corresponding LD_{50}. This information will be obtained according to the formula found in Section 66261.24.(c) CCR 22 for the determination of cumulative toxicity.

Where the dermal (or oral) toxicity of the waste $= \dfrac{100}{\dfrac{wt\%a}{LD50a} + \dfrac{wt\%b}{LD50b} + \dfrac{wt\%c}{LD50c} + \dfrac{wt\%n}{LD50n}}$

Where a,b,c....n represents different waste constituents with listed toxicity thresholds.

This number generated by the weight percent of a particular material in a waste will then be divided by it's LD_{50}, to obtain a "relative toxicity ratio".

This research will then apply this California regulatory formula: 100 divided by the sum of the relative toxicity ratios. The application of this protocol will then determine if the waste is cumulatively toxic for dermal and oral toxicity for the product constituents, by comparing this number to the regulatory threshold. This calculation will also be performed as an added tool in evaluated inhalation toxicity.

The second page of these toxicity interpretive charts will include the metals data from this historical analysis of the waste. The metals data will be described in the same fashion as that of the floor finish products with the exception of the column “Chemical Concentration in (the) Product”.

Acute Fish Toxicity

The primary data from a single waste sample from the analysis of the wastewater from floor finish removal will be used to evaluate the cumulative acute toxicity of wastewater from floor finish removal at LLNL. This fish bioassay test was completed along with TTLC metals analysis and pH. This toxicological data (see appendix I) will be described and analyzed in Chapters 4 and 5.

Research Subproblem Three: Container Evaluation

All portable tank data will be obtained to answer the question: Which portable container, of those used at the LLNL facility, is most suitable for the storage and on site transportation of wastewater from floor finish removal operations? Both primary and secondary data will be used in this evaluation of the portable tanks. Primary data will be obtained with a survey of the different LLNL technicians who use portable containers frequently (see Appendix J). Those technicians surveyed included: Hazardous Waste Management: Field Technicians; Lawrence Livermore Site 300 Field Technicians; Liquid Waste Treatment Technicians and Environmental Restoration Division Technicians. This survey is designed to evaluate the different containers (on a relative basis) used for wastewater management on the LLNL site. The containers evaluated include:

1. 55 gallon closed top drum.
2. 330 gallon polyethylene "Tuff Tank".
3. 660 gallon polyethylene portable tank.
4. 625 gallon stainless steel portable tank.
5. 750 gallon stainless steel portable tank.
6. 500 gallon, trailer mounted, round, polyethylene tank.
7. 500 gallon "duo containment" portable tank.

This primary data from the survey will then be summarized in a database specific for each group of LLNL technicians. See appendix K.

Secondary data on these portable containers will then be obtained by the tank manufacturers to determine the specifications of the individual containers along with their cost and any documentation that these tanks might have regarding their Department of Transportation (DOT) certification. This data will be obtained through directly contacting the container manufacturer or through the HWM Procurement Coordinator, Sandy Guntrum.

Together, the primary data from the survey of the technicians, along with information obtained from the tank manufacturer, will be utilized in the development of an interpretive chart designed to make a comparative evaluation of the portable containers utilized at LLNL for wastewater management.

Container Interpretive Chart

The interpretive chart for the primary container will contain specific categories for evaluation. In the evaluation process each container will be scored relative to the other containers. The scoring of the containers will be subjective, but based on the information provided by the container manufacturers and the surveys of the LLNL technicians. The scoring will be from 0 - 10, 10 being the best score. Upon evaluation of each individual category, each tank will have a cumulative score. The highest cumulative score will indicate the best overall score, and the best portable tank for on site wastewater storage at LLNL. The different categories used in the evaluation process will include the following: value (pts.): This is the relative score for a particular container characteristic. The scoring is designed such that it is possible for all containers to receive the same score for any of the different categories.

Cost: This is the cost of the container as provided by the tank manufacturer or the HWM procurement coordinator.

H.W. Storage: Hazardous Waste Storage. This category refers to the secondary containment of the different containers. Containers which can be easily secondarily contained earn the highest score.

Non-Haz Storage: Non-hazardous waste storage, refers to the general characteristic of that particular container to be stored easily on site. A filled container which requires a large cemented area to safely store a non-hazardous waste would receive a poorer score than a filled container that could be stored in a small shed.

Storage volume: This category refers to the wastewater storage volume. The greater the storage volume, the better the score.

Valve arrangement: Refers to the valves on the tank, and their ability to be easily, safely and reliably transfer wastewater.

Durability-Maintenance. Is the characteristic of the container to work well for a long time, with out degradation. Secondarily, container repair and maintenance will be evaluated in assigning a value in this category.

Ease of obtaining a representative sample: Containers are comparatively evaluated based on their ability to have a representative sample removed from their storage area. A flat bottomed container will score higher in this test, than a container with a curved bottom because it's generally easier to obtain a more accurate sample from it.

Lifespan-recycling: Refers to the ability of the container to be reused safely over time.

Ease of sludge removal: The quality of a tank to have the solids removed from it after the liquids have been removed. Containers with sloping bottoms which drain to valves, and large manways will score relatively well in this category.

Ease of waste transfer: This category refers to the ability of a container to be safely and easily "pumped out", or filled with waste. Containers which have 2" quick connect fittings, (cam lock fittings) score well when compared with those that don't because 2" cam fittings attached to 2 inch hose lines are the standard within the Hazardous Waste Management Division (HWM).

Ease of Transport: Is the characteristic relating to the ease of transportation of this container on the LLNL facility. Forklifts are plentiful within the HWM facility, consequently, containers which can be moved by forklift will receive a better score than those that can not.

TOTAL POINTS: The sum of the points for that particular container. The higher the score the better the portable container is for waste management on the LLNL facility.

CHAPTER 4

RESEARCH DATA AND ANALYSIS

Introduction

Data collected and analyzed in this section will be laid out and described in the same order as each of the subproblems:

1. The statistical classification of wastewater from floor finish removal, to determine if the waste is hazardous.
2. The determination of the waste as a toxic waste using the California hazardous waste regulations.
3. The determination of the most appropriate container for the management of wastewater from floor finish removal when managed on the LLNL site.

The data used for the statistical analysis of wastewater has been collected and displayed in three kinds of tables and one or two kinds of figures:

1. The sample data table.
2. The statistical table (derived from the sample data).
3. Interpretive table.
4. Probability plots.
5. Histograms (zinc hybrid data only).

Together the zinc, lead and pH analytical data in these tables and chart(s) will be used to determine if the waste is hazardous or not when evaluated by the "General Procedures" in Chapter 9 of SW-846: "STRATEGY FOR DETERMINING IF CHEMICAL CONTAMINANTS OF SOLID WASTES ARE PRESENT AT HAZARDOUS LEVELS". The evaluation of this data will include criticism of: data transformations (arcsine, square root, logarithmic); the analytical data bases applied, (TTLC, STLC hybrid, and STLC ratio); and the SW-846 General Procedure itself.

The data used in the determination of the wastewater as a toxic waste by California hazardous waste regulations will then be evaluated. This data is presented in two different tables: the cumulative toxicity table, and the waste constituent ranking table. These tables will express information available in toxicological reference books, material safety data and evaluate the information according to California waste regulations to determine if the waste is hazardous or not.

Acute aquatic toxicity (of wastewater from floor finish removal) will be evaluated independently using one comprehensive set of analytical data. This evaluation of aquatic toxicity is also discussed in relationship to the entire data base of wastewater analysis presented in the statistical classification of the waste.

Chronic toxicity is also discussed briefly as it relates to the classification of wastewater from floor finish removal.

Lastly the different containers used to manage waste on the LLNL site: 55 gallon drum, 330 gallon Tuff tank, 660 gallon polyethylene tank, 625 gallon steel tank , 750 gallon steel tank and the 500 gallon duo containment tank will be described and comparatively evaluated to determine which container, or containers are most appropriate for the storage of wastewater from floor finishing. This comparative analysis is subjective and specific to the on site management of the wastewater. This container evaluation will be summarized using the “portable container interpretive chart”.

Statistical Analysis of Wastewater from Floor Finish Removal

The data tables for the statistical analysis of wastewater from floor finish removal will be divided into subsections based on each analyte that triggered the hazardous waste regulatory threshold in California: zinc, lead and pH. Each of these analytes has a data table, statistical table, probability charts and an interpretive chart associated with it. These tables and figures were specifically formatted to be applied to the General Procedures within Chapter 9 of SW-846 for the determination of the waste as hazardous. As a reminder, assumptions five and six in Chapter One in relevant part state: wastewater from floor finish removal operations (at LLNL) is homogeneous, and the statistical methodologies described in SW-846 are appropriate for determining if this wastewater is hazardous.

These General Procedures, along with the statistical equations used in Chapter 9 of SW-846 and in the statistics tables are reprinted in Appendices D and E. Given an historic database of samples from 18, 55 gallon drums it was necessary to adapt the General Procedures slightly in evaluating wastewater as a hazardous waste. The adaptations to the General Procedures are described as follows.

Step 1 of the General Procedures in hazardous waste classification involves estimating the mean and the variance of the hazardous constituents. This step is not relevant because this research begins the statistical evaluation given 18 samples with 18 sets of corresponding analytical data for each analyte of concern, zinc, lead, and pH. Given this information then, we can calculate the actual mean, and variance of the TTLC metals (lead, zinc) and the pH.

Step 2 of the General Procedures requests an estimate of the number of samples needed to make a waste determination based on an estimate of the mean and variance. Since we have actual values of the mean and variance from 18 samples, equation 8 can be used to calculate the number of samples needed to determine if the waste is hazardous. These calculated number of samples needed “n”, to make a hazardous waste determination are illustrated in the statistics table for zinc, lead and pH.

Step 3 involves the collection of “n” samples as determined from equation 8. The collection and analysis of the appropriate number of samples is limited by the 18 samples of 55 gallon drums.

Step 4 is the analysis of “n” samples and the graphing of this analytical data for “superficial” examination of the data for “obvious departures from normality”. This research will accurately graph, using comprehensive probability plots, the different manipulations of the STLC-TTLC data, and pH using the different data transformations addressed in SW-846 (arcsine transformation, square root transformation) along with the logarithmic transformation.

Step 5 involves the calculation of the mean, standard deviation, and standard error for each set of data. This research calculates the mean and standard deviation. This information is summarized in the statistical table for the appropriate analyte. The standard error was not calculated because it was not necessary in making a hazardous waste determination.

Step 6 requires the comparison of the mean concentration of the analyte to the regulatory threshold in order to determine if the data points are normally distributed. This research looks closely at the different data transformation in light of the comparison of the mean with the variance.

Step 7 involves the calculation of the 90% CI for each analyte and comparison to the appropriate RT. This research completes step 7 in the statistical table and also compares the 90% CI and the RT of each analyte in the interpretive charts for each analyte using each data base (TTLC, STLC hybrid, STLC ratio) using each of the different transformations described in Chapter 3.

Step 8 describes the re-estimation of the number of samples needed (using the 18 pieces of data) where the 90% confidence interval exceeds the RT. This step is addressed for the TTLC zinc, which was the only database which exceeded the regulatory threshold.

Step 9 involves the reevaluation of the additional samples taken and analyzed to determine if the newly calculated 90% CI is less than the appropriate RT. This research is limited to the analytical data from the 18 drums sampled.

Analysis of the Metal Databases

The databases of analytical data from wastewater sampling applied to the SW-846 General Procedures to determine if the waste is hazardous for a particular analyte are different. Each of the three metal databases generated from the analysis of the wastewater: TTLC database; STLC hybrid database and STLC ratio applied to the SW-846 methodology generate very different results regarding the hazardous nature of the waste.

The TTLC, or total metal database at first appears to be the most appropriate for waste determination because every container used in this study has been analyzed for the total metal concentration. In fact this data would be appropriate given that this wastewater is a liquid with less than 0.5 percent filterable solids. Where the waste contains less than 0.5 percent solids, after filtering, the TTLC analysis can be completed and compared to the STLC regulatory threshold. In October of 1992 the percent solids of this wastewater was evaluated from eight different drums (see appendix F). The average solids content of the waste was found to be 4.65%, with a range in values of .42% to 11.56%. Clearly from these samples representing 44% of the 18 samples in the database this wastewater has a solids content well above the 0.5%, the limit for comparing the total metal concentration (TTLC value) to the soluble threshold (STLC RT).

Although the TTLC data is inconclusive because the wastewater has greater than 0.5 percent solids, if the soluble fraction (STLC) was not determined, and the TTLC analysis exceeds the STLC regulatory threshold, LLNL will correctly and conservatively manage this waste as hazardous. Given this knowledge, from Table 4.2 (Zinc Data) and Table 4.5 (Lead Data), five 55 gallon drums will be managed conservatively as hazardous waste because the TTLC lead and zinc concentrations exceeded the appropriate STLC RTs.

The TTLC data is evaluated in this research in comparison to the STLC threshold of 250 mg/l. In the evaluation of zinc TTLC database, nine of the 18 drums exceed the STLC regulatory threshold (Table 4.2)! For the lead TTLC database, six drums, one third of the database exceeded the STLC regulatory threshold. However four of these six drums (9202989, 9202998, 9203000, 9203001) were not managed as hazardous because the STLC analysis was performed, and the results fell below the RT.

When evaluating the TTLC database(s) as a whole, which is required when statistical evaluation of the entire waste stream is completed, the mean concentration for the zinc is well above the STLC threshold, suggesting the wastestream as a whole is potentially hazardous waste. However when the TTLC data and the STLC data is combined as in the STLC hybrid far different results are found.

The STLC hybrid database is formed with the available STLC data for the particular analyte combined with the TTLC analysis for the remaining drums where an STLC analysis was not performed. The STLC and TTLC data are combined and evaluated together as one data set. The influence of the STLC data is expressed by a substantial lowering of the mean concentration of the analyte of concern, producing a more accurate representation of soluble fraction of the metal. The problem with this STLC hybrid is not one of conservatively evaluating the waste but a statistical problem of using different types of data and combing them together (MacQueen 1995). In reality this research shows this STLC hybrid as an appropriate method of characterizing the waste because data used is from actual sampling and analysis, the results are conservative, health protective, and provide a mean concentration of the analyte which is higher than the STLC ratio.

By using the STLC data where available, and combining this with the TTLC data from the other drums (STLC hybrid), the 90% confidence interval falls from 413.6 ppm to 208.2 ppm, (see Table 4.3). This hybrid data now shows the zinc concentration of the wastewater to be non-hazardous. The lead 90% confidence interval drops also, but this drop is less significant because the values in the TTLC database were low to begin with. Consequently when using the STLC data in combination with the TTLC data the zinc and lead constituents are present below the hazardous waste RTs.

The STLC ratio as described in Chapter Three is composed of available STLC values and an artificial STLC value generated by the highest soluble ratio found in any particular sample of the analyte of concern. These greatest soluble fractions (STLC/TTLC) are provided in the following table.

Table 4.1. Soluble Fraction Conversion: STLC Ratio

Metal	Sample No.	STLC	TTLC	STLC / TTLC
Zinc	9202995	520	940	56%
Lead	9202996	0.2	0.4	50%

This STLC ratio is dependent on the number of STLC analysis completed. Where a greater number of STLC analysis are completed from the set of 18 drums sampled a better estimate of the soluble fraction can be determined. In this case seven of the 18 samples taken have an STLC value. By using the highest soluble sample this research believes that a reasonable estimate of the STLC value can be obtained by multiplying this STLC/TTLC fraction by the TTLC value of concern. Given that this wastewater is relatively homogeneous, and generated using consistent methods and processes the STLC ratio should give a relatively accurate soluble fraction for the metals in wastewater from floor finish removal. The STLC ratio is more statistically correct, because the data set is composed of the same types of data, all STLC data values, and is therefore more statistically valid than the STLC hybrid data set (MacQueen 1995). The problem with this data is not that it is an accurate estimator of STLC values, or statistically valid, but that it is the least conservative of the three data sets, and more significantly it is not yet understood by those regulating hazardous waste (DTSC, EPA).

When the STLC ratio is used in estimating the 90% confidence intervals for the metals; the zinc confidence interval drops from 208.2 ppm to 180.4 ppm (RT = 250 ppm), and the lead 90% confidence interval drops from 3.7 ppm to 2.0 ppm (RT = 5 ppm). This data set like the hybrid data indicates that the metal concentrations in this wastestream are not present at hazardous levels.

Analysis of the pH Database

The pH data is easier to evaluate than the metals data because only one data set is used in the statistical analysis. The problem with the pH data is, only metal contaminants are used and applied to the statistical methodology in SW-846. Another factor effecting the accuracy of the classification of the corrosivity of the waste is the laboratories method of providing pH results. Where the pH of a sample equals or exceeds the regulatory threshold of 12.5 on the pH scale, the analytical results are written as >12.5. In evaluating samples 9300544, 9300545, and 9300546, where the results were >12,5 this research chose the conservative approach and evaluated these samples as if they each had a pH of 14.0.

The calculated 90% confidence interval for the untransformed pH data set provides a pH of 11.1, below the regulatory threshold of 12.5, even though three samples out of 18 were conservatively valued at pH 14. The fact that 13 of the 18 data points show a relatively narrow pH range of 9.6 - 11.0 also supports the conclusion that the untransformed pH data set indicates that wastewater from floor finishing is not a corrosive waste (Table 4.8).

pH is also a logarithmic scale which may raise questions in a regulators mind on how this data set can be transformed. MacQueen (1995) stated that the pH being in logarithmic scale does not effect the statistical evaluation, and ultimately the determination of the waste as hazardous or not.

Analysis of the Statistical Data

This research evaluates and applies the arcsine transformation, square root transformation (described in Chapter 9 of SW-846) as well as the log transformation to each analytical database (from floor finish removal waste) described earlier. The function of these data transformations is to alter each data value by a mathematical operation, such as the square root of each value in the data set, to obtain a more normally distributed data set, which can then be evaluated statistically. Where statistics are applied to a database which is abnormally distributed the results can not be accurately applied to the database in making decisions on the characteristics of the data. Specifically an accurate mean concentration, or 90% confidence interval can not be determined and evaluated with regulatory thresholds where the data set has an abnormal distribution.

This research includes the logarithmic data transformation in making the hazardous waste determination because of it's relevance in normalizing data from environmental systems (MacQueen 1994; Fordham 1995). "As a general recommendation, the normal and log - normal distributions are the best representations of most environmental data and probably cover 99% of all cases." (Fordham 1995). The log transformation will then be evaluated comparatively with the arcsine transformation and the square root transformations in determining if wastewater from floor finish removal is hazardous. See appendix G.

Chapter 9 of SW-846, specifically requests the use of data transformations where: graphical representation of the data set indicates an abnormal distribution, or the mean concentration in the database is approximately equal to or less than the variance (See appendix E). Step six of the General Procedures for waste determination says: "... consider transforming the data by the square root transformation (if the mean is about equal to variance) or the arcsine transformation (if the mean is less than variance)." This research will now apply the SW-846 General Procedures as modified, to the different data sets of wastewater from floor finish removal at LLNL.

Application of the SW-846 General Procedures

Following is a discussion of the zinc, lead and pH databases (from the 18 samples taken from the 18 55 gallon drums) and their application to the General Procedures in SW-846 in determining if the waste is hazardous.

Zinc

Beginning with the zinc data (including probability charts and histograms) it is not clear by using the TTLC data alone if the zinc is present at hazardous levels. The algorithm in step 6 states that the arcsine transformation is appropriate where the mean is less than the variance. In the case of the TTLC data the mean concentration is 312 ppm and the variance is 104,782. Using this information the arcsine transformation is the clear choice. Examination of Figure 4.2 of the arcsine transformation of the TTLC data in comparison with the other transformations of the TTLC data (Figure 4.3 and Figure 4.4) raises several points.

1. The arcsine plot mimics the untransformed data.

2. The plot of the arcsine, and untransformed data does not match well with the normal distribution fit line.

3. All of the TTLC databases indicate that the 90% upper confidence level (UCL) is above the STLC regulatory threshold except for the log transformation.

4. The log transformation of the TTLC database provides the best match to the normal distribution line.

5. For the log transformation the 90% UCL is below the STLC threshold and therefore indicates that this wastestream is not a hazardous waste for the zinc analyte.

This first point regarding the arcsine being a duplicate of the untransformed data is repeated with the lead and pH data, (Figures 4.17, 4.18 and Figures 4.29, 4.30). This duplicate plotting of the untransformed data by the arcsine transformation is caused by the methodology of the transformation. This transformation first involves the conversion of the values in the database to a percentage, and then transforming this number by the arcsine. A key point is the arcsine transformation of the value, expressed in percent, must be transformed using the mathematically correct unit of radians (MacQueen 1995). A common mistake here is to convert the data value to a percent value and then complete the arcsine transformation using the degree unit, the most frequently used unit of measure on the hand held calculator. In effect then the arcsine transformation divides the values in the database by 10,000. When this arcsine transformation is plotted there will be no change from the untransformed data!

The second point regarding the poor match of the arcsine, and untransformed data to the normal distribution fit, is not uncommon. This fact indicates that the untransformed data may benefit by a transformation but clearly not the arcsine transformation. These first two issues brings into question the comparison of the mean concentration with the variance as a reasonable approach in determining how to transform or normalize a data set. In the text *Environmental Statistics* (Patil, and Rao, 1994) on page 830 discuss the comparison of the mean with the variance, stating it is completely inappropriate for determining the arcsine transformation where the mean is less than the variance. In addition Patil, Rao note that the use of the comparison of the mean with the variance is a poor tool for determining the correct data transformation. They go on to state in regards to the SW-846 statistical approach to waste classification that "It is difficult to image that this regulation had received adequate technical review".

Point three through five raises additional questions on waste classification using the TTLC database. In this situation, the untransformed data and the only two data transformations addressed in SW-846 indicate the zinc is present at hazardous levels. The log transformation which is recognized as being a statistically valid transformation indicates that this wastestream is not hazardous for zinc. This situation could easily put hazardous waste regulators with out a strong background in statistics at odds with the waste generator, and statisticians who are trying to characterize waste accurately.

Following step seven of The General Procedures (appendix E) to the tee, using the TTLC database, and the arcsine transformation, a new "n", (number of samples) is obtained (Table 4.3), or a tentative conclusion of hazardous is made. In this case 49 samples are required to characterize the waste properly. Therefore 31 additional samples must be taken! At approximately $250 dollars per sample this sampling effort is inappropriate and the wastestream should be considered hazardous for zinc.

Evaluation of the hybrid database and database transformations (Figures 4.5 - 4.8) shows that when the STLC analysis are included, in every case, zinc is not present at hazardous concentrations. This data set as a whole also matches the normal distribution fit better than the TTLC data. Here again the log transformation, along with the square root transformation match the normal distribution fit better than the untransformed data and the SW-846 recommended arcsine transformation.

In evaluation of the histograms (Figures 4.9 - 4.12) for the zinc hybrid database it appears the square root transformation provides the most normally distributed database. The use of the histogram in this case, provides additional information that suggests that the comparison of the mean (164 ppm) to the variance (20335) as a method of determining the appropriate transformation, is not a good one. For waste classification of this database the histograms do not provide any additional insight since the zinc hybrid data is below the RT for each condition.

Analysis of the zinc ratio database and its transformations repeat the points raised in the evaluation of the TTLC database and the hybrid database. The log transformation clearly matches the normal distribution fit line the best, and in every case the 90% UCL is below the regulatory threshold for zinc.

In evaluating the interpretive chart for zinc there are several points which stand out.

1. When only TTLC sample values are considered, and the STLC values are tossed out, the waste is hazardous in three out of the four transformations.

2. For the hybrid population, and zinc ratio categories where the STLC zinc values are included in the statistical calculations, the waste is non-hazardous in 100% of the cases.

3. The log normal transformation, not utilized in SW-846 is the best data transformation for zinc as represented in Figures: 4.4, 4.8, 4.12, 4.16, 4.20, 4.24. 4.28 and 4.32.

4. Although the zinc ratio has greater statistical validity it is at this time not an excepted practice, additionally it could be considered less conservative than the zinc hybrid data, where only actual sample values are used in the classification of the waste. Consequently this research assigned the highest value to the log transformation of the hybrid data as the most accurate and appropriate for waste classification of this wastewater.

5. Based on evaluation of all the probability plots, and the interpretive chart this research shows that wastewater from floor finish removal is not a hazardous waste based on it's zinc content.

Table 4.2. Zinc Data

Sample #	**Date**	**TTLC Zinc** (mg/kg)	**STLC Zinc** (mg/l)	**STLC Zinc Ratio** (mg/l)
9201026	5/04/92	42		24.4
9201027	5/04/92	62		36
9201028	5/04/92	59		34.2
9201399	5/28/92	16		9.3
9202426	8/25/92	160		92.8
9202428	8/25/92	51		29.6
9202429	8/25/92	260		150.8
9202989	10/20/92	270	88	
9202994	10/20/92	900	410	
9202995	10/20/92	940	520	
9202996	10/20/92	770	310	
9202998	10/20/92	480	140	
9203000	10/20/92	800	190	
9203001	10/20/92	300	130	
9300544	2/18/93	30		16.7
9300545	2/18/93	100		55.5
9300546	2/18/93	300		166.5
9400201	1/24/94	73		40.5

Table 4.3. Zinc Statistics

	Untrans	Arcsine	Sq. Root	Log
TTLC				
mean	311.8	.0312	15.3	2.21
std. dev.	323.7	.032	9.0	0.55
variance	104756.1	.001	81.9	.31
SW846CV	336.0	.0337	5.35	0.14
coef vr 2	1.0	1.04	0.59	0.25
U.C.L.	413.6	.0414	18.2	2.39
t-hold	250.0	.0250	15.8	2.40
calculated "n"	49.0	49.0	588.0	16.00
decision	hazardous	hazardous	hazardous	non-haz
STLC#1: Hybrid				
mean	163.4	.0163	11.7	2.05
std. dev.	142.6	.0140	5.3	0.41
variance	20340.7	.0002	28.4	.17
SW846CV	124.0	.0125	2.43	0.08
coef vr 2	0.9	0.8700	0.46	0.20
U.C.L.	208.2	.0208	13.4	2.18
t-hold	250.0	.0250	15.8	2.40
calculated "n"	5.0	5.0	3.0	3.0
decision	non-haz	non-haz	non-haz	non-haz
STLC#2: Ratio				
mean	135.2	.0135	10.2	1.89
std. dev.	143.9	0.0140	5.7	0.49
variance	20716.9	.0002	32.1	.24
SW846CV	153.0	.0153	3.13	0.13
coef vr 2	1.1	1.0600	0.55	0.26
U.C.L.	180.4	0.0180	12.0	2.05
t-hold	250.0	0.0250	15.8	2.40
calculated "n"	3.0	3.0	2.0	2.0
decision	non-haz	non-haz	non-haz	non-haz

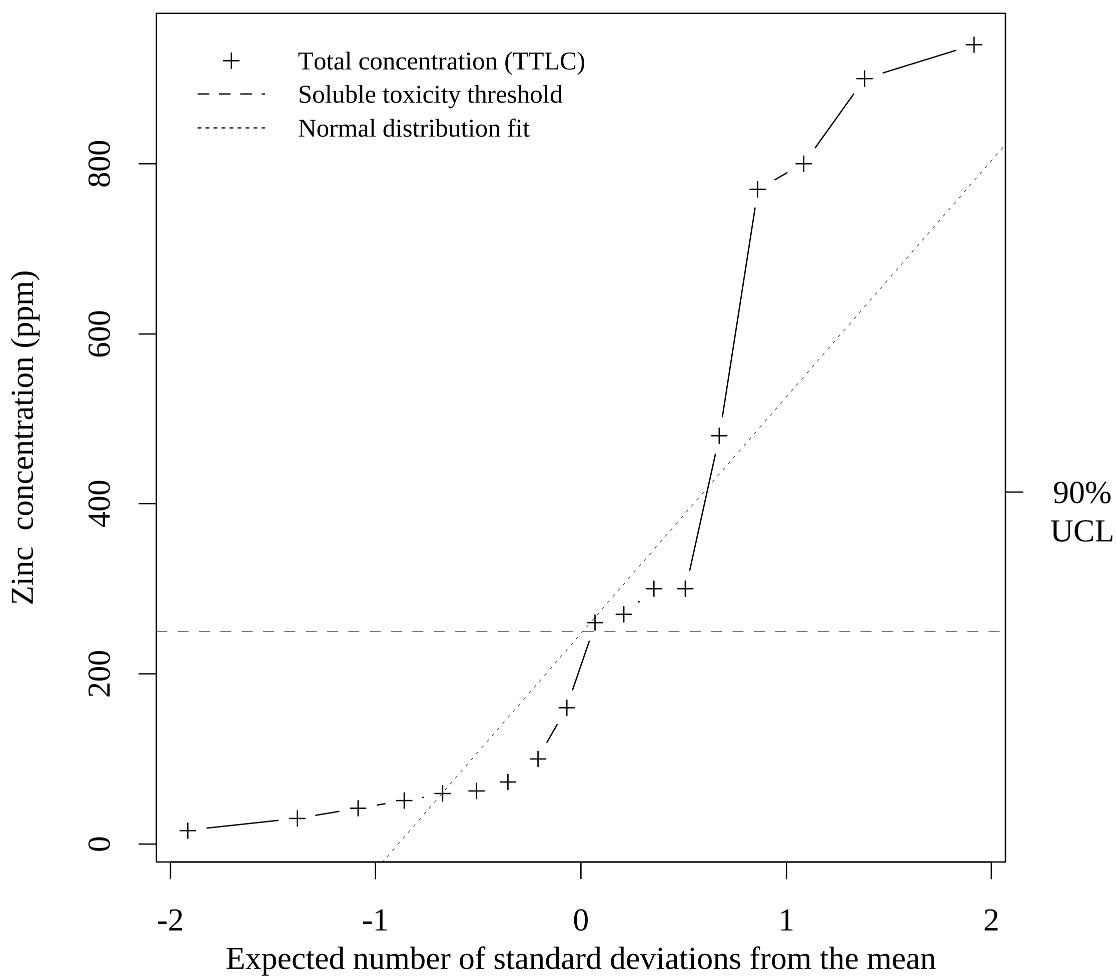

Figure 4.1. Total Zinc (TTLC), Untransformed Data

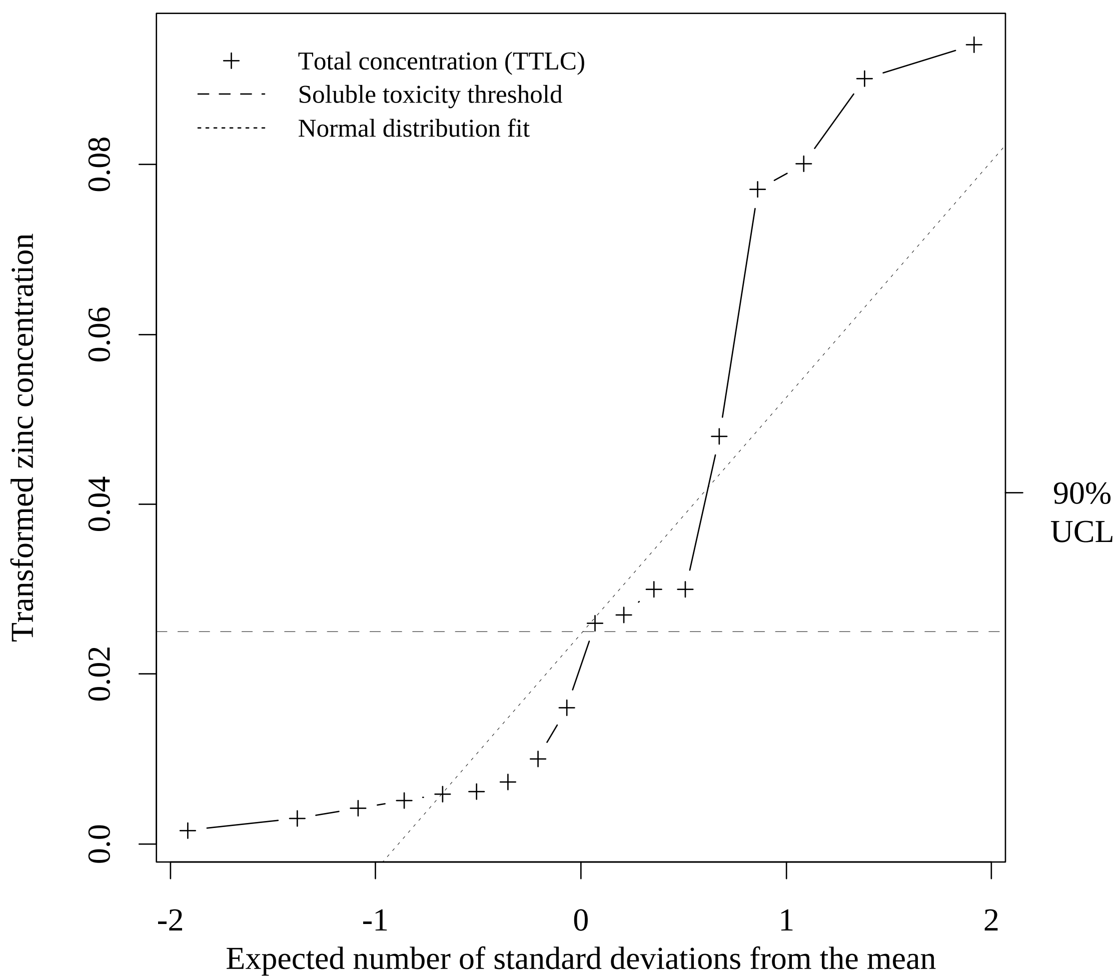

Figure 4.2. Total Zinc (TTLC), Arcsine Transformation

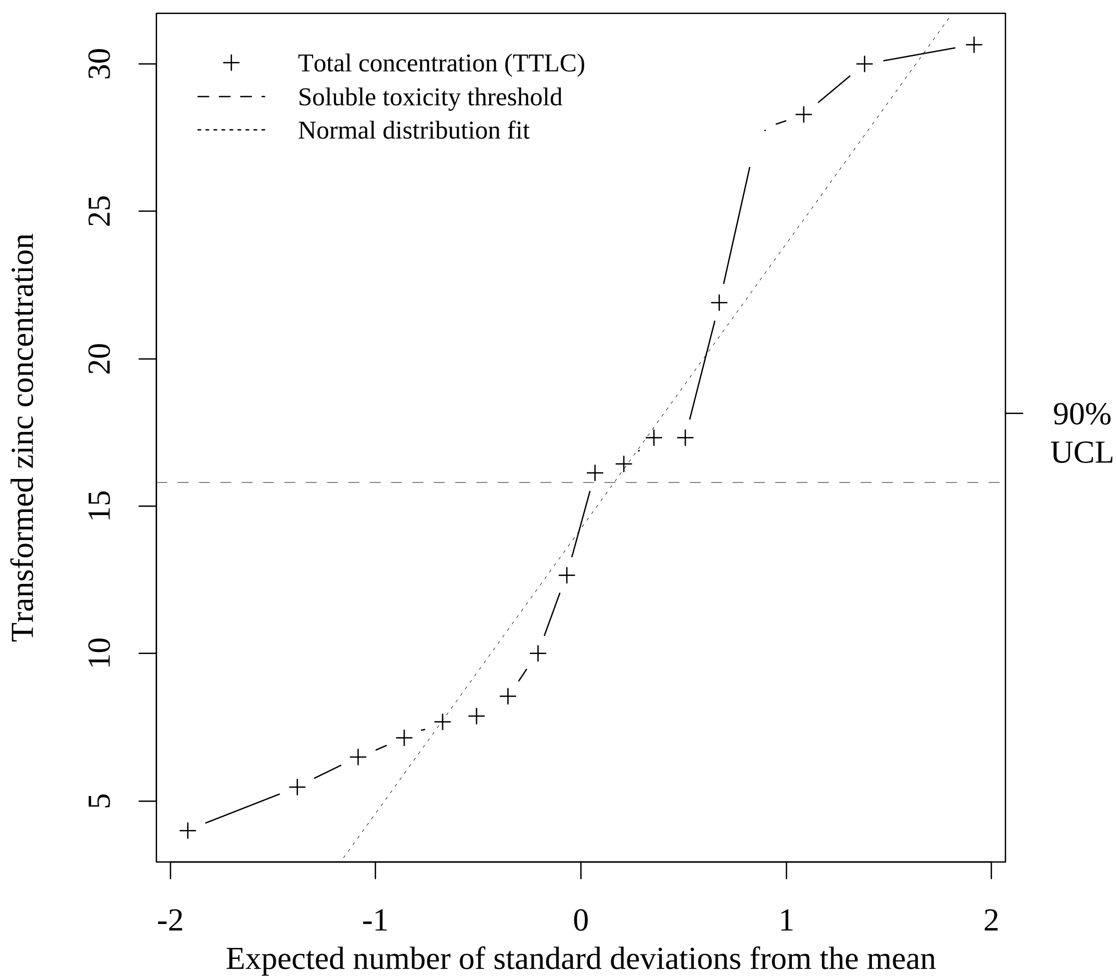

Figure 4.3. Total Zinc (TTLC), Square Root Transformation

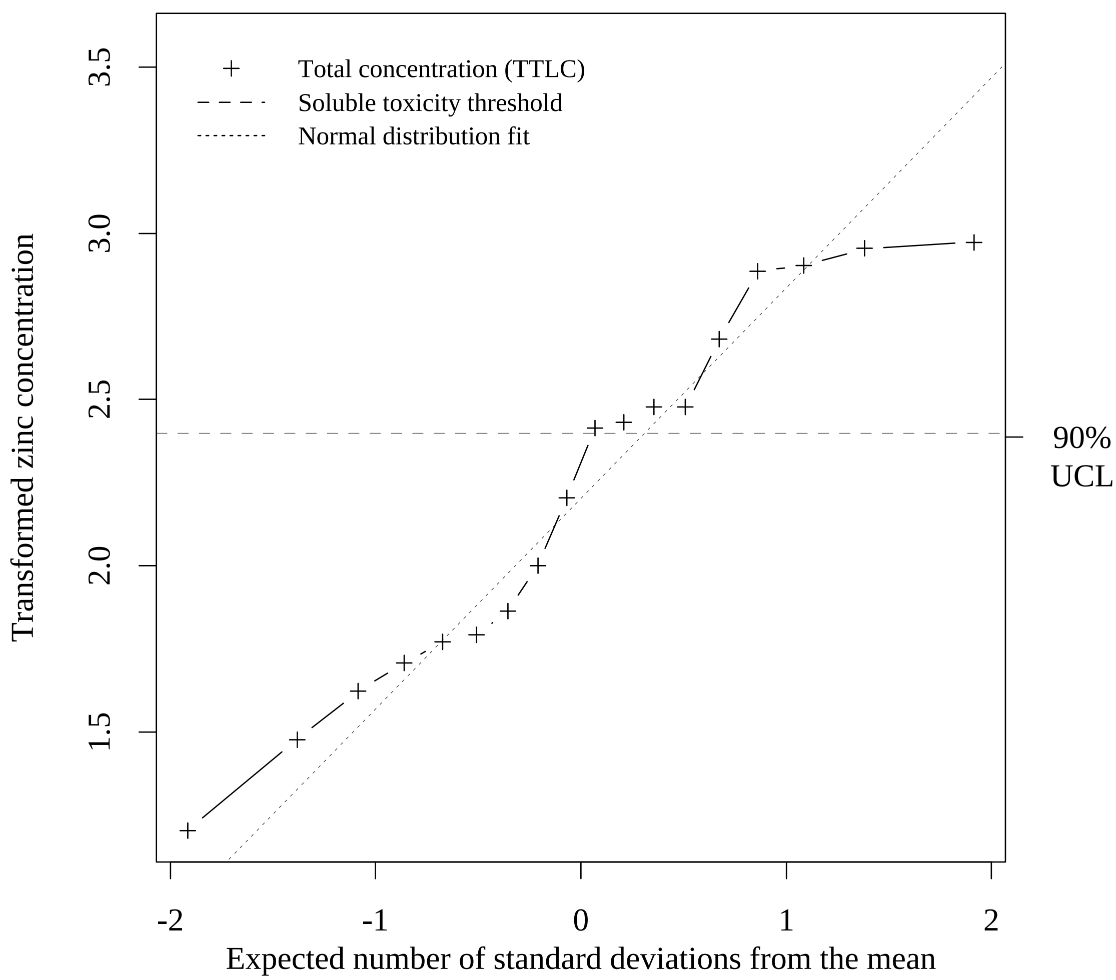

Figure 4.4. Total Zinc (TTLC), Log Transformation

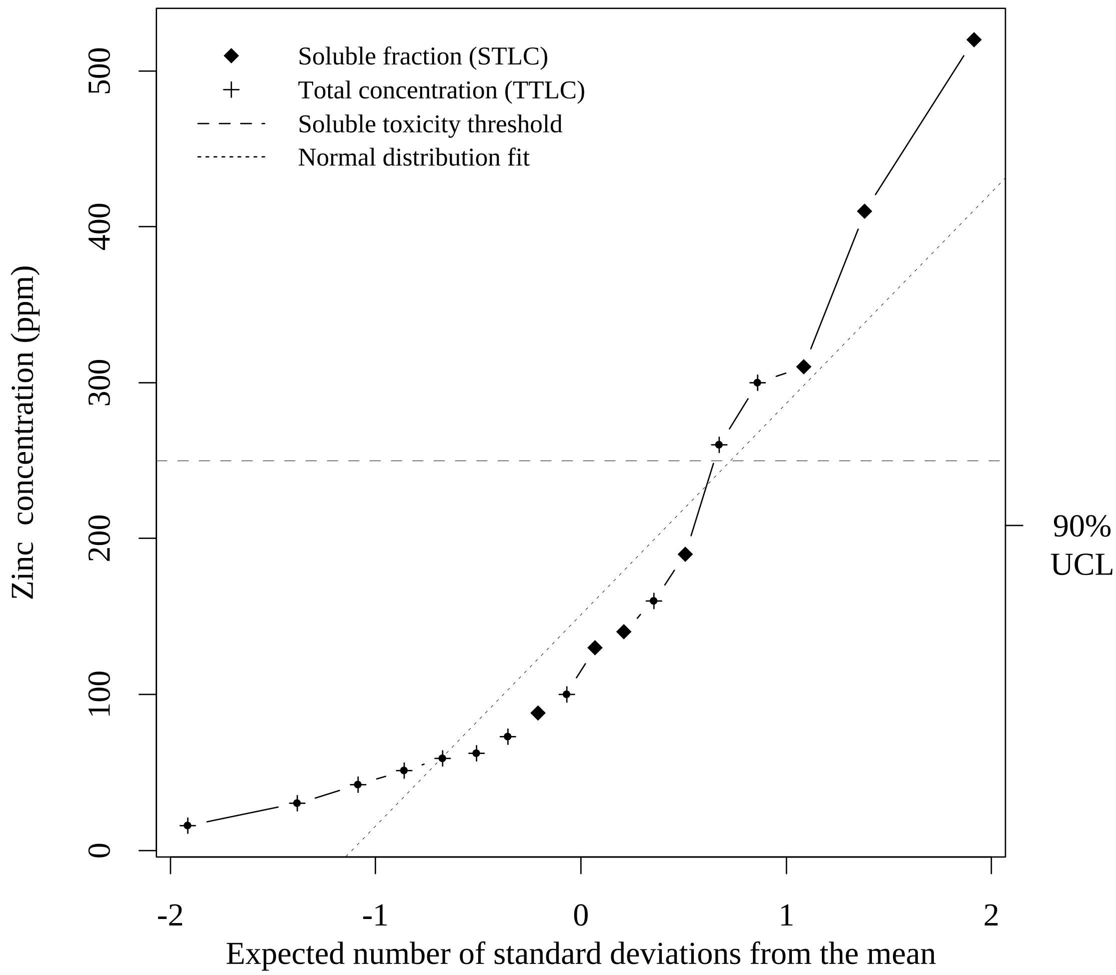

Figure 4.5. Zinc Hybrid, Untransformed Data

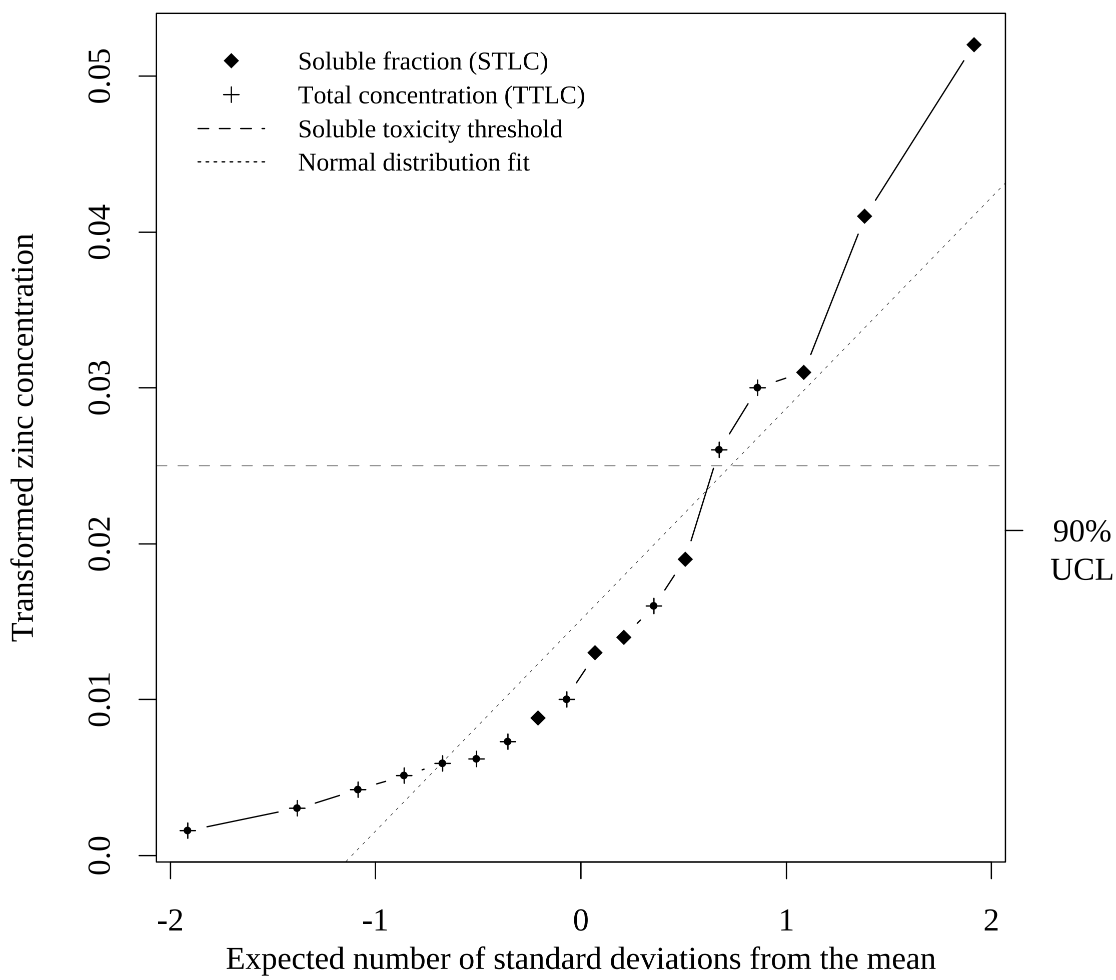

Figure 4.6. Zinc Hybrid, Arcsine Transformation

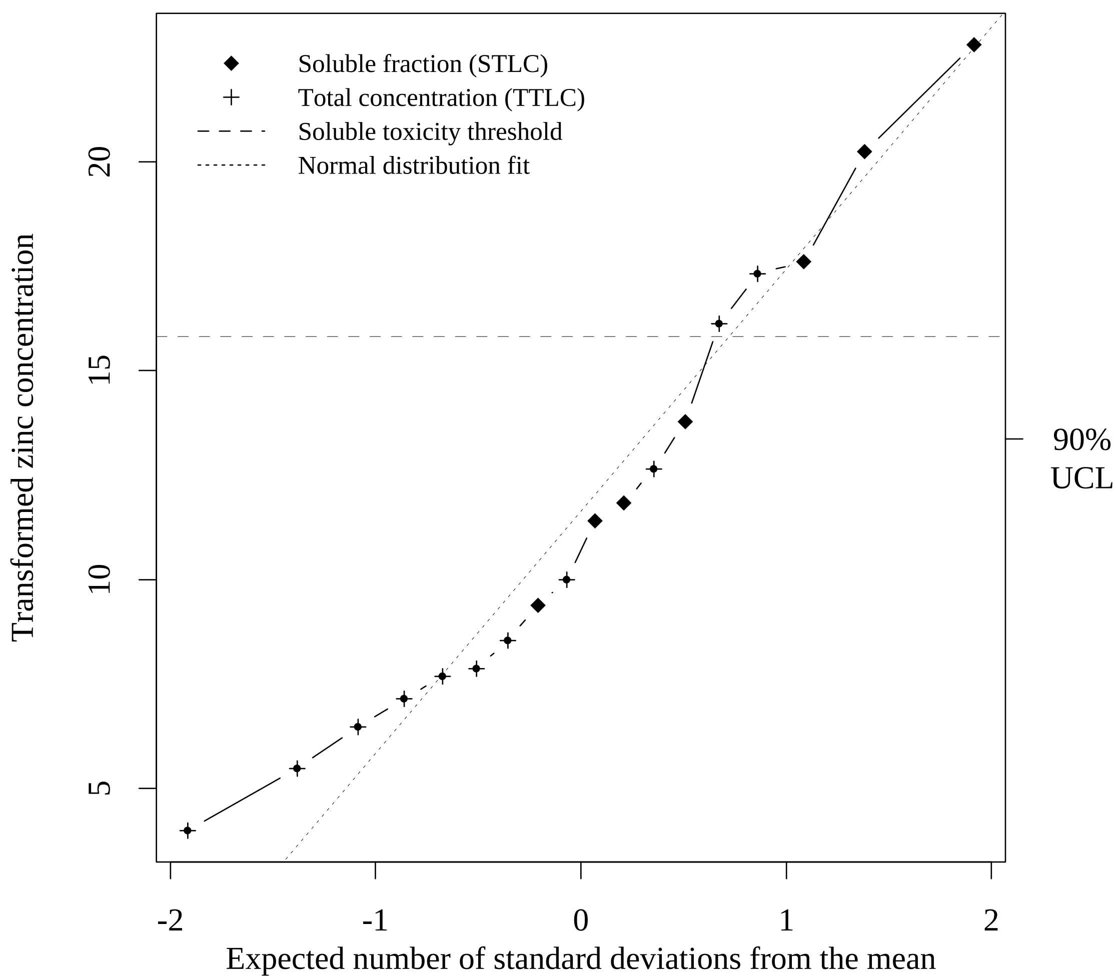

Figure 4.7. Zinc Hybrid, Square Root Transformation

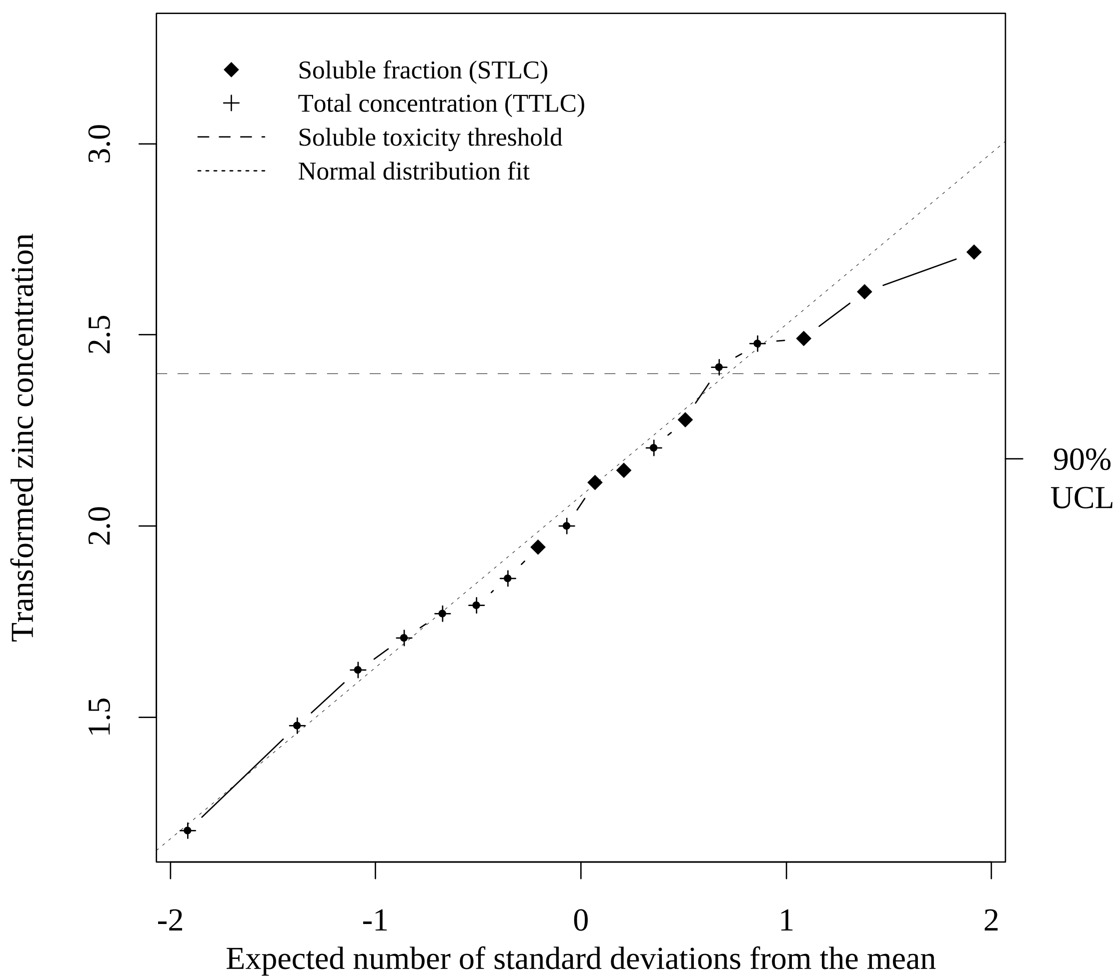

Figure 4.8. Zinc Hybrid, Log Transformation

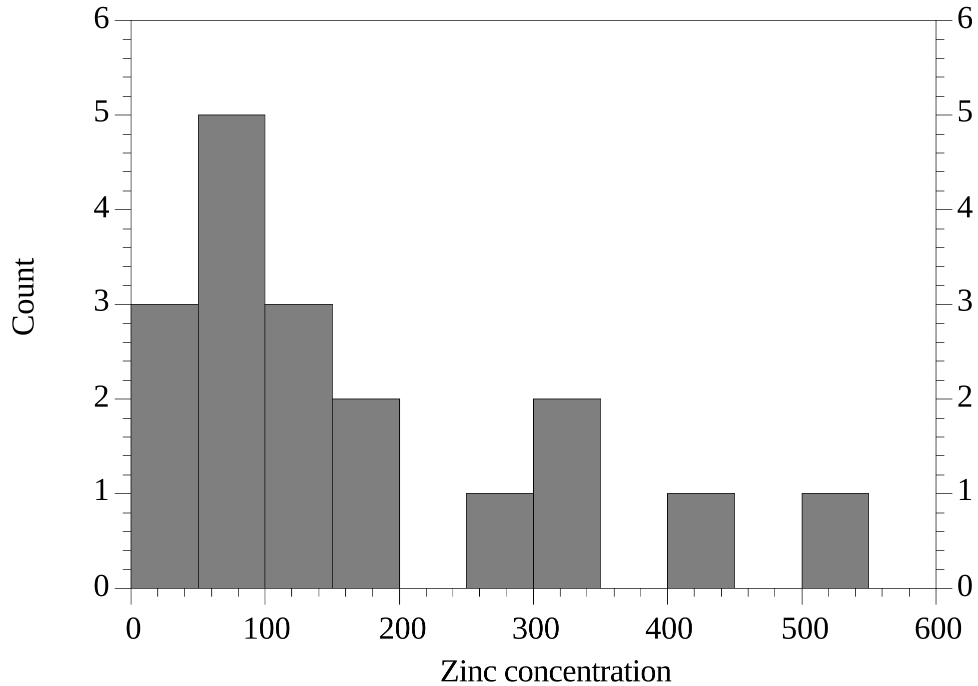

Figure 4.9. Zinc Hybrid, Untransformed Data

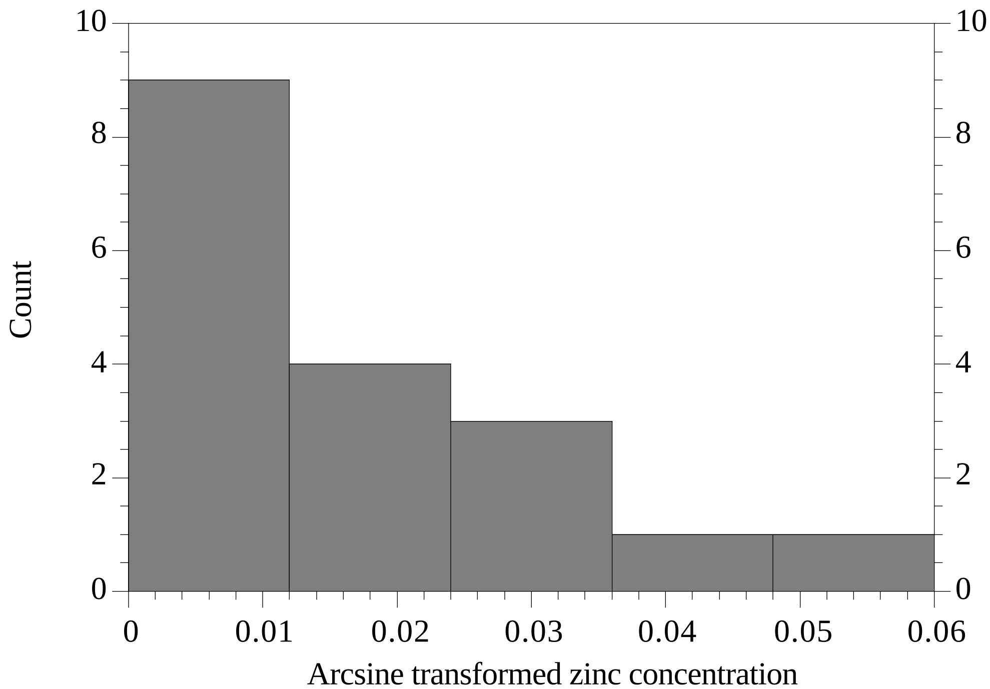

Figure 4.10 Zinc Hybrid, Arcsine Transformation

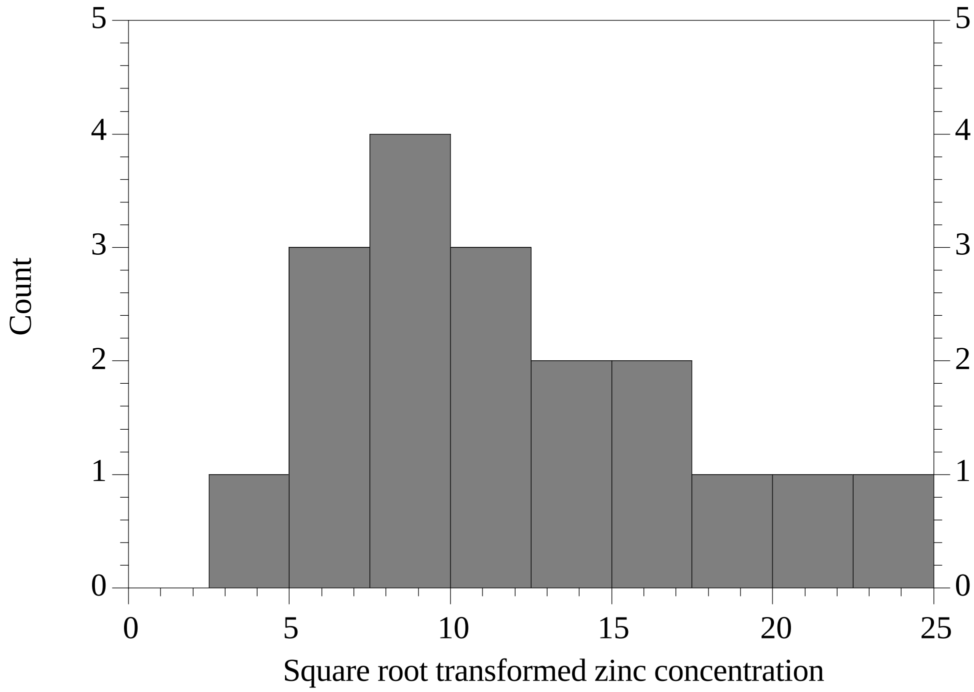

Figure 4.11. Zinc Hybrid, Square Root Transformation

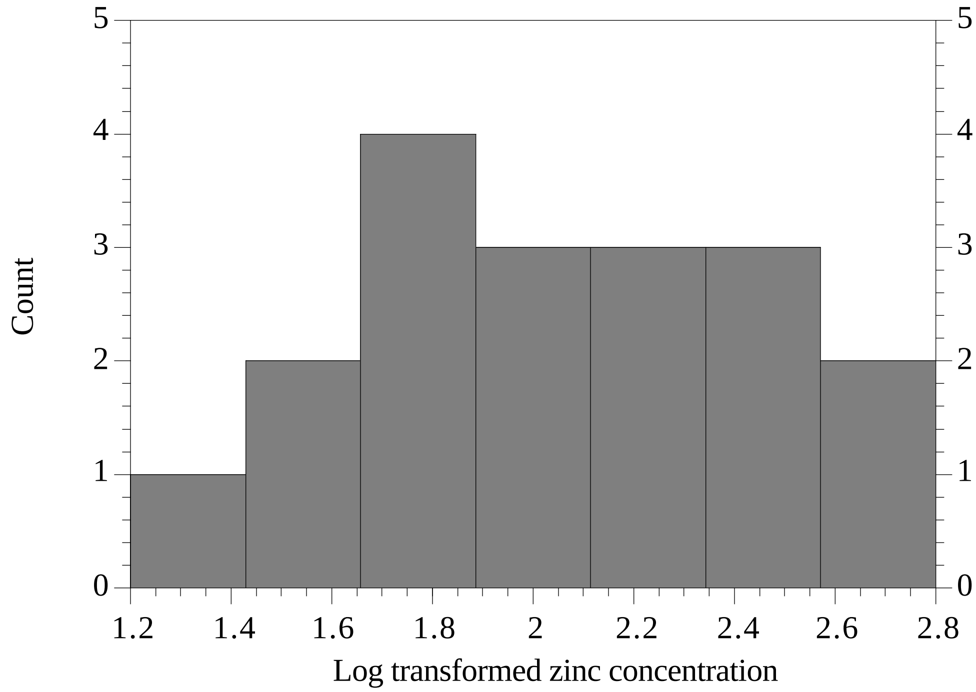

Figure 4.12. Zinc Hybrid, Log Transformation

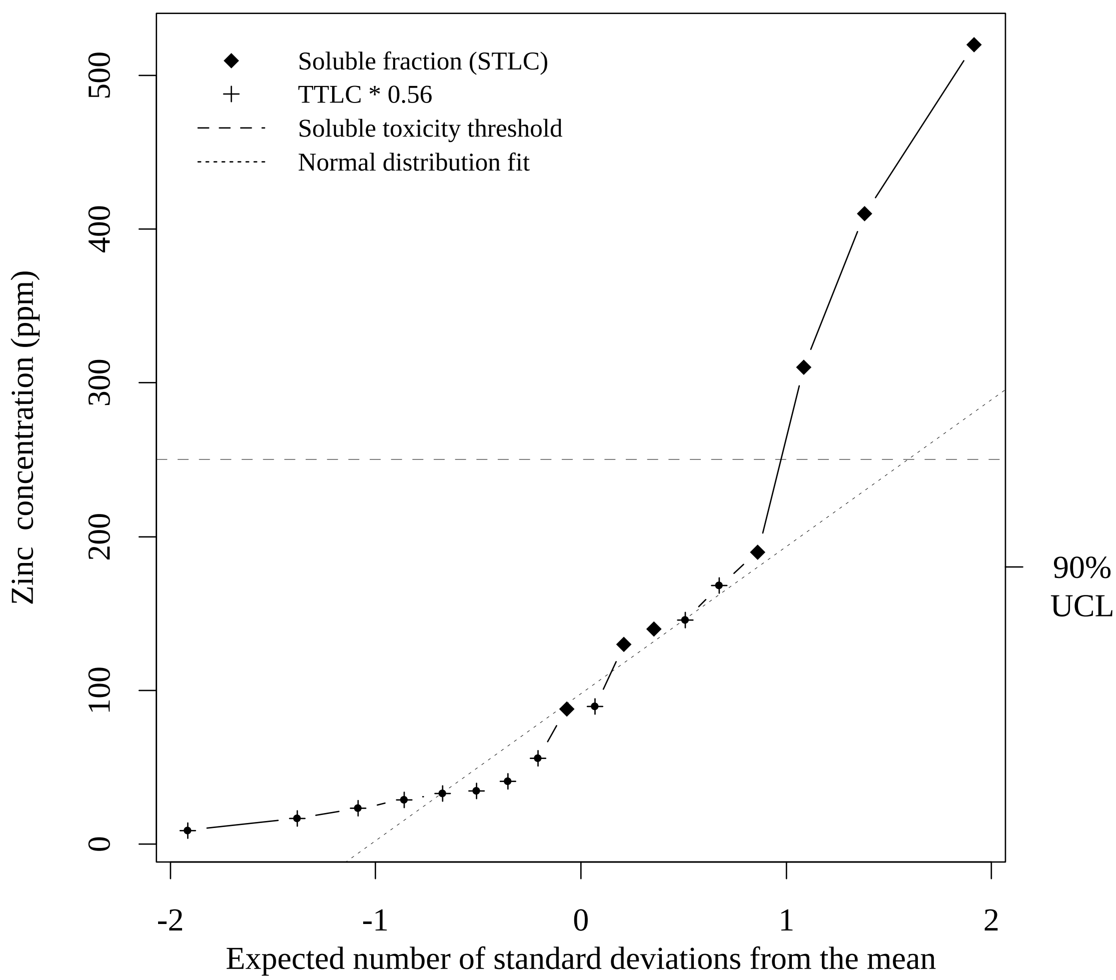

Figure 4.13. Zinc Ratio, Untransformed Data

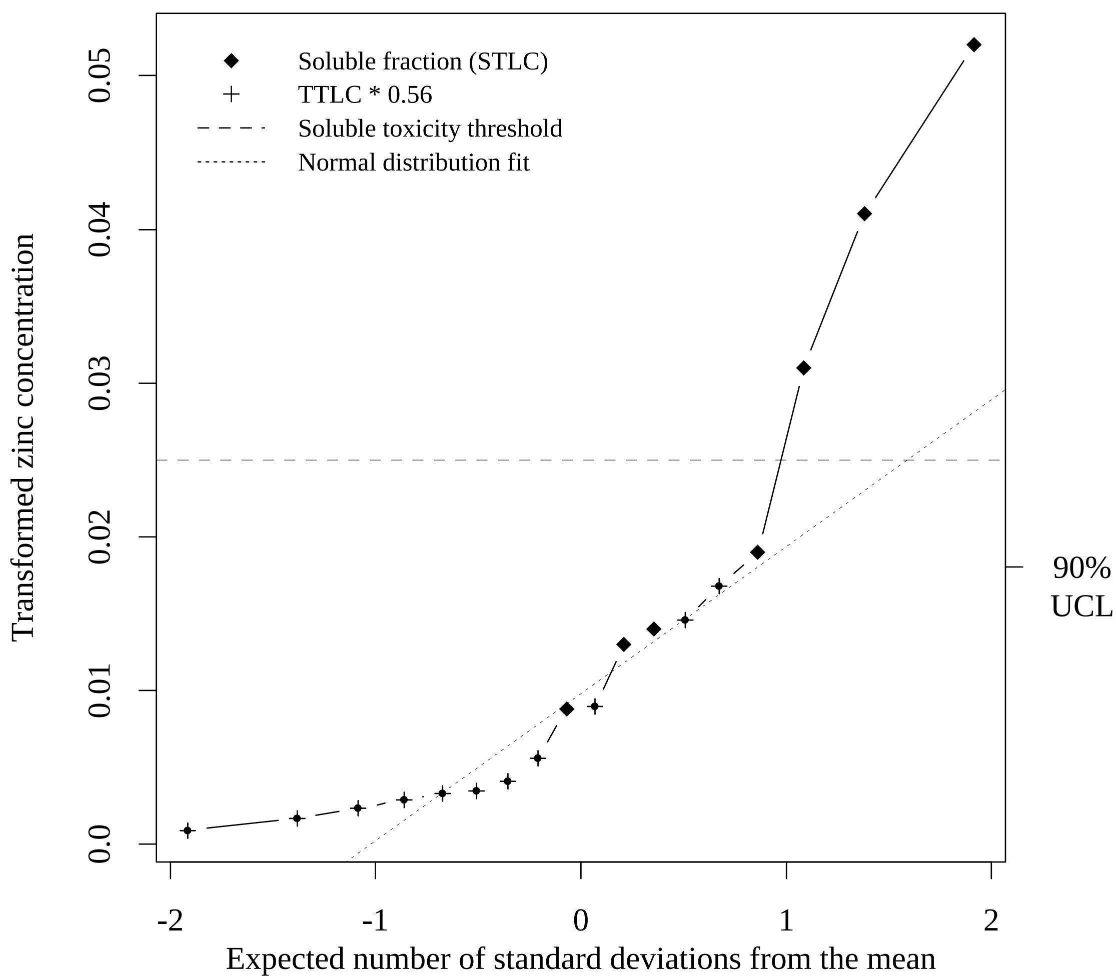

Figure 4.14. Zinc Ratio, Arcsine Transformation

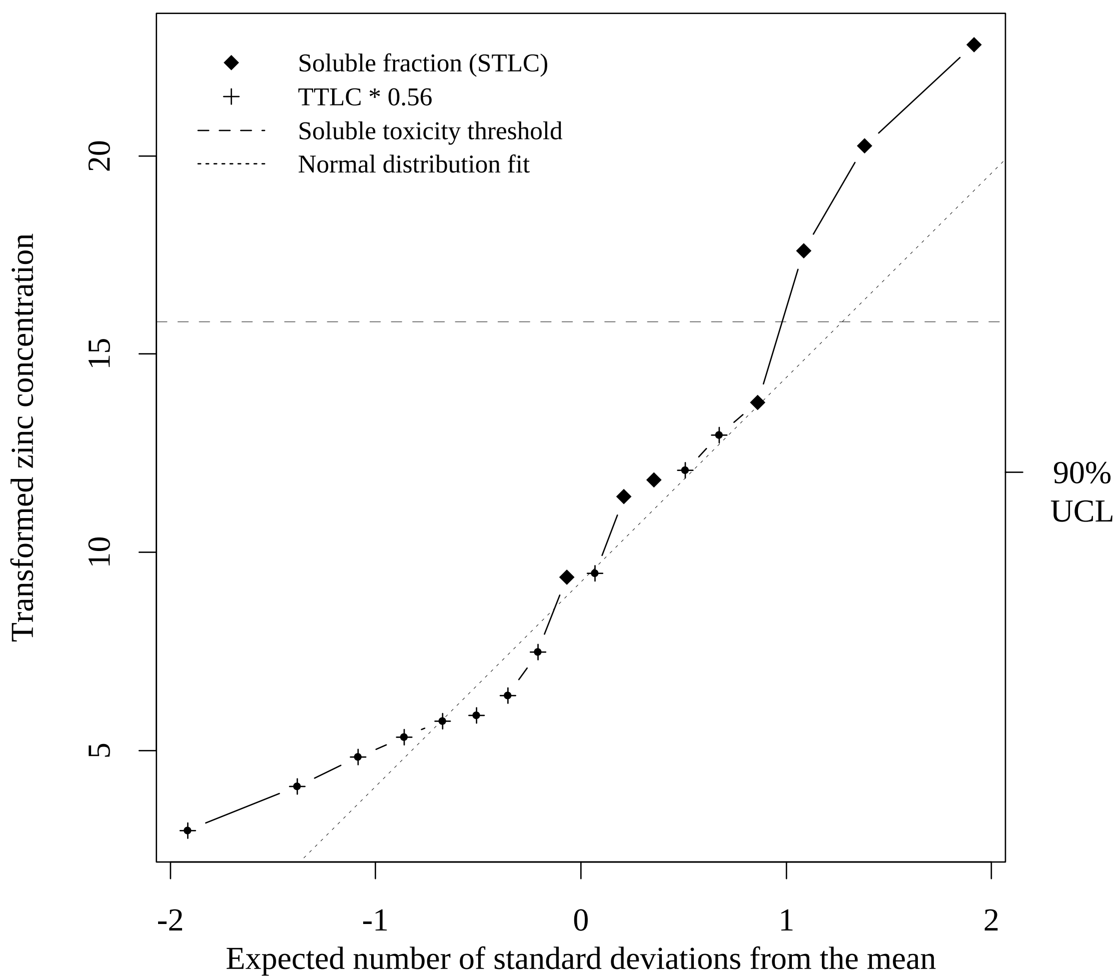

Figure 4.15. Zinc Ratio, Square Root Transformation

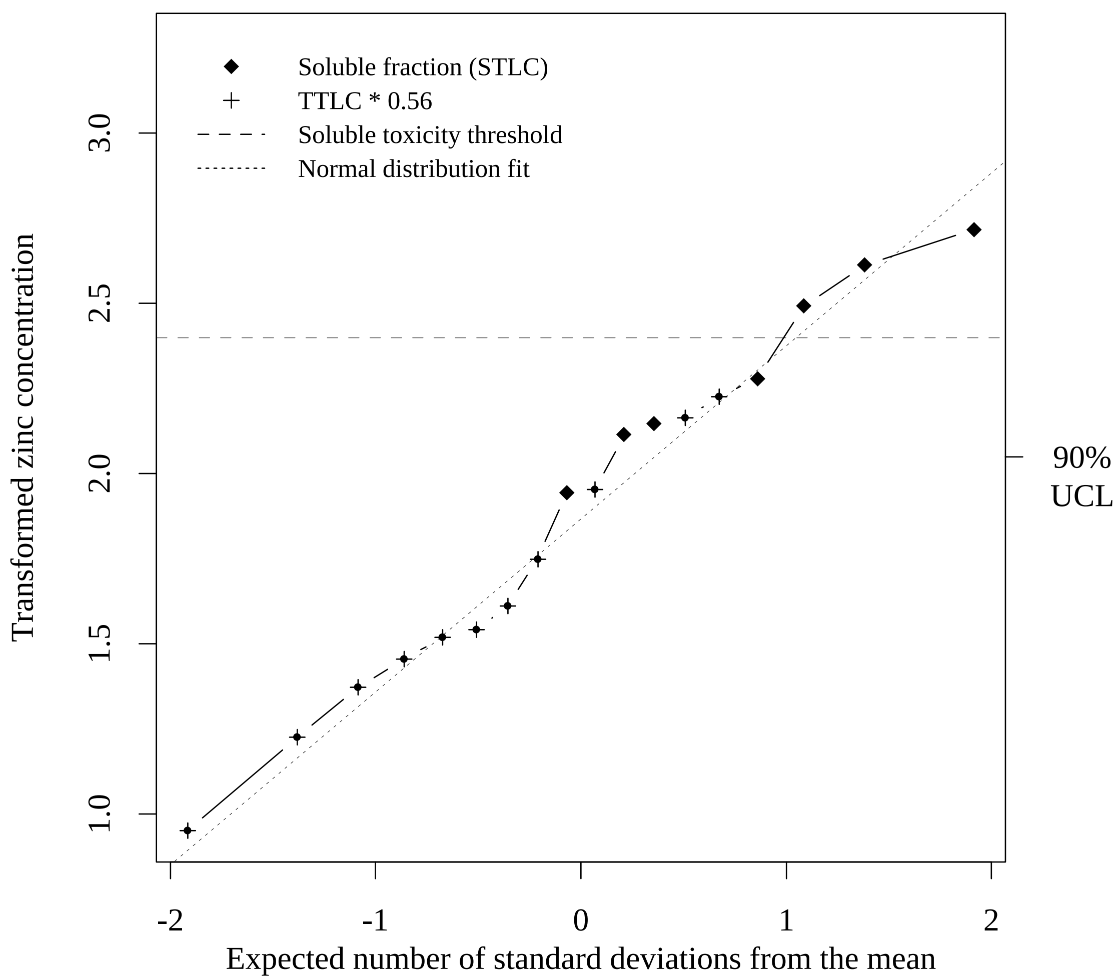

Figure 4.16. Zinc Ratio, Log Transformation

Table 4.4. Zinc Data Interpretive Chart				
	Normal Distribution	**Arcsine Transform.**	**Square Root Transform.**	**Log Transform.**
TTLC Zinc				
Distribution Fit	poor	poor	below average	good
90% CI	413.60	0.041	18.2	2.39
Reg. T.hold	250.00	0.025	15.8	2.4
90% CI/R.T.	1.65	1.656	1.15	1.00
Hazardous Determination	yes	yes	yes	no
Validity, application	**5**	**1**	**2**	**6**
Zinc Hybrid				
Distribution Fit	below average	below average	good	very good
90% CI	208.2	0.0208	13.400	2.18
Reg. T.hold	250	0.025	15.800	2.4
90% CI/R.T.	0.8328	0.832	0.848	0.908
Hazardous Determination	no	no	no	no
Validity, Application	**9**	**2**	**3**	**10**
Zinc Ratio				
Distribution Fit	poor	poor	good	excellent
90% CI	180.4	0.018	12	2.05
Reg. T.hold	250	0.025	15.8	2.4
90% CI/R.T.	0.72	0.72	0.759	0.854
Hazardous Determination	no	no	no	no
Validity, Application	**7**	**1**	**4**	**7**

Lead

The evaluation of the lead statistics tables, and probability plots did not reveal anything new of significance that wasn't already addressed during the discussion of the zinc contaminant. Of interest is the fact that the lead STLC is 5.0 mg/l and the TTLC is 1000 mg/kg, 200 times the STLC level. The highest lead value found in any of the eighteen samples is 8.3, smaller than the STLC threshold by a factor of 100. Without the knowledge that this waste has greater than 0.5 percent solids the waste is characterized as a California and Federal hazardous waste for lead (using TTLC data) where the STLC was not determined.

In evaluation of the probability plots and the Interpretive Chart (Table 4.7) for lead the following points can be made.

1. Lead is below all appropriate regulatory thresholds using each database for the untransformed data and every data transformation.

2. The square root transformation over all, provides the best match of the data to the normal distribution fit.

3. The lead hybrid database scored the highest for validity and application when using the untransformed data, and the log transformation of the data. These high scores were achieved for different reasons. The untransformed data received a high score because actual sample values were used, and the ease of application (data transformation was not utilized). The log transformation of the hybrid data scored well because actual data was used, and the statistical relevance of the transformation.

4. The statistically valid STLC lead ratio database shows the lowest relative toxicity as expressed by the UCL/RT further indicating that the lead is not present in the wastewater at hazardous levels.

Table 4.5. Lead Data

Sample #	**Date**	**TTLC Lead** (mg/kg)	**STLC Lead** (mg/l)	**STLC Lead Ratio** (mg/l)
9201026	5/04/92	3.0		1.5
9201027	5/04/92	3.0		1.5
9201028	5/04/92	4.0		2.0
9201399	5/28/92	0.05		0.025
9202426	8/25/92	8.0		4.0
9202428	8/25/92	8.0		4.0
9202429	8/25/92	6.0		3.0
9202989	10/20/92	8.3	2.5	
9202994	10/20/92	1.0	0.2	
9202995	10/20/92	7.7	0.8	
9202996	10/20/92	0.4	0.2	
9202998	10/20/92	2.0	0.4	
9203000	10/20/92	3.9	0.71	
9203001	10/20/92	2.8	0.48	
9300544	2/18/93	3.0		1.5
9300545	2/18/93	4.0		2.0
9300546	2/18/93	3.0		1.5
9400201	1/24/94	5.0		2.5

Table 4.6. Lead Statistics

	Untrans	**Arcsine**	**Sq. Root**	**Log**
TTLC				
mean	4.1	0.00041	1.9	0.44
std. dev.	2.6	0.00026	0.7	0.55
variance	6.76	6.76 E-8	.6	.30
SW846CV	2	0.0002	0.30	0.68
coef vr 2	0.64	0.64	0.40	1.25
U.C.L.	4.9	0.0005	2.1	0.61
t-hold	5.0	0.0005	2.2	0.70
calculated "n"	14.0	14.0	8.0	8.0
decision	non-haz	non-haz	non-haz	non-haz
STLC#1: Hybrid				
mean	2.9	0.00029	1.5	0.17
std. dev.	2.6	0.00026	0.8	0.64
variance	6.6	6.6 E-8	.7	.41
SW846CV	2	0.0002	0.46	2.34
coef vr 2	0.89	0.89	0.55	3.67
U.C.L.	3.7	0.0004	1.8	0.37
t-hold	5.0	0.0005	2.2	0.70
calculated "n"	3.0	3.0	3.0	3.0
decision	non-haz	non-haz	non-haz	non-haz
STLC#2: Ratio				
mean	1.6	0.00016	1.2	-0.01
std. dev.	1.2	0.00012	0.5	0.56
variance	1.5	1.5 E-8	0.3	0.32
SW846CV	1.0	0.0001	0.25	-32.06
coef vr 2	0.77	0.77	0.47	-56.78
U.C.L.	2.0	0.0002	1.3	0.17
t-hold	5.0	0.0005	2.2	0.70
calculated "n"	1.0	1.0	2.0	1.0
decision	non-haz	non-haz	non-haz	non-haz

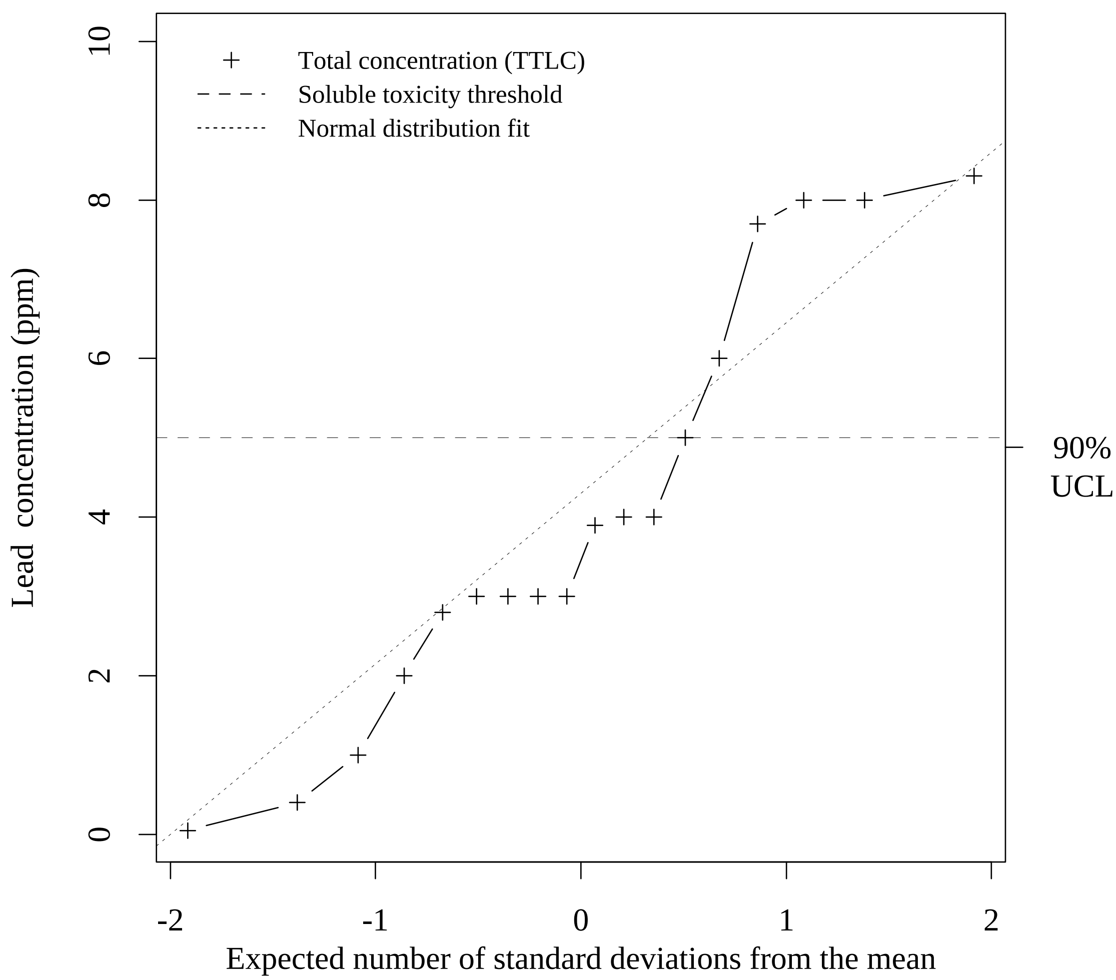

Figure 4.17. Total Lead (TTLC), Untransformed Data

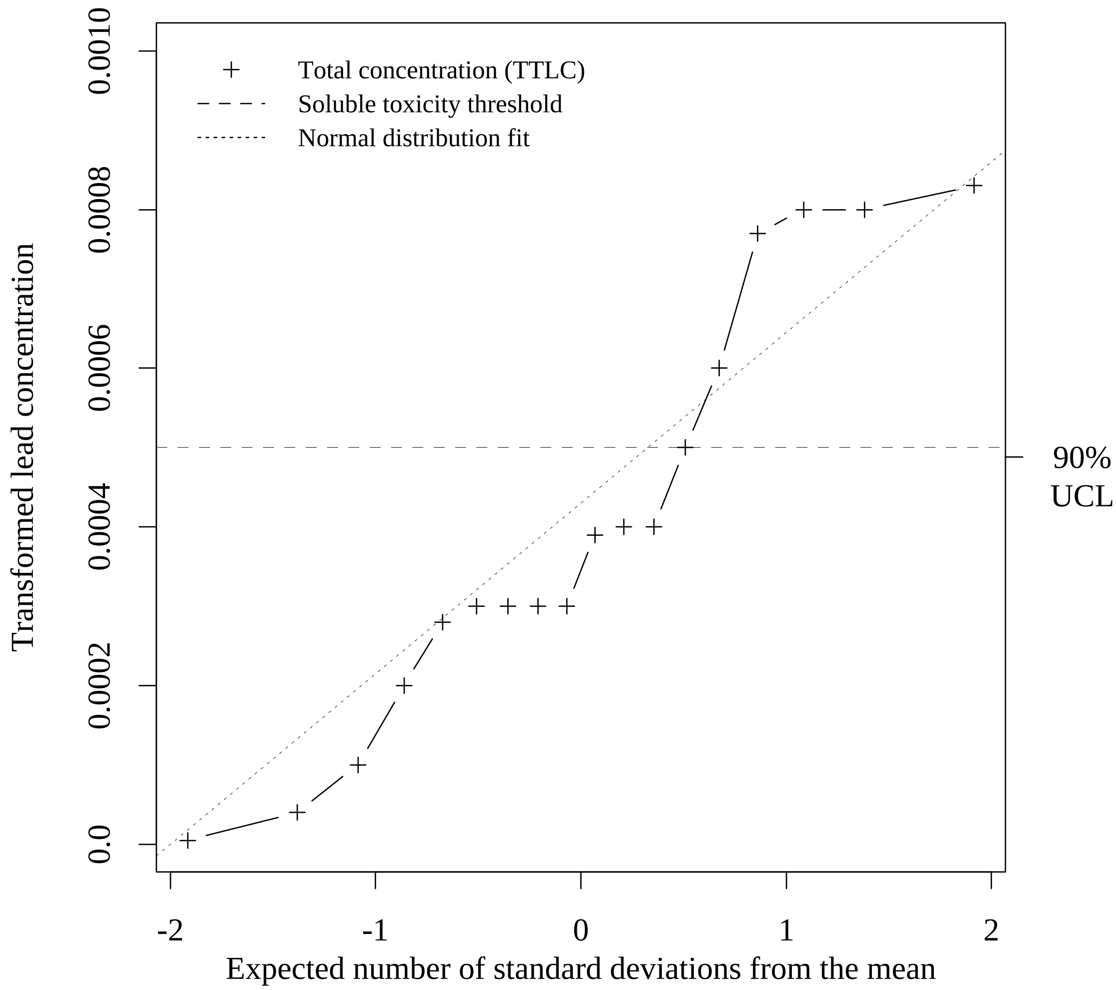

Figure 4.18. Total Lead (TTLC), Arcsine Transformation

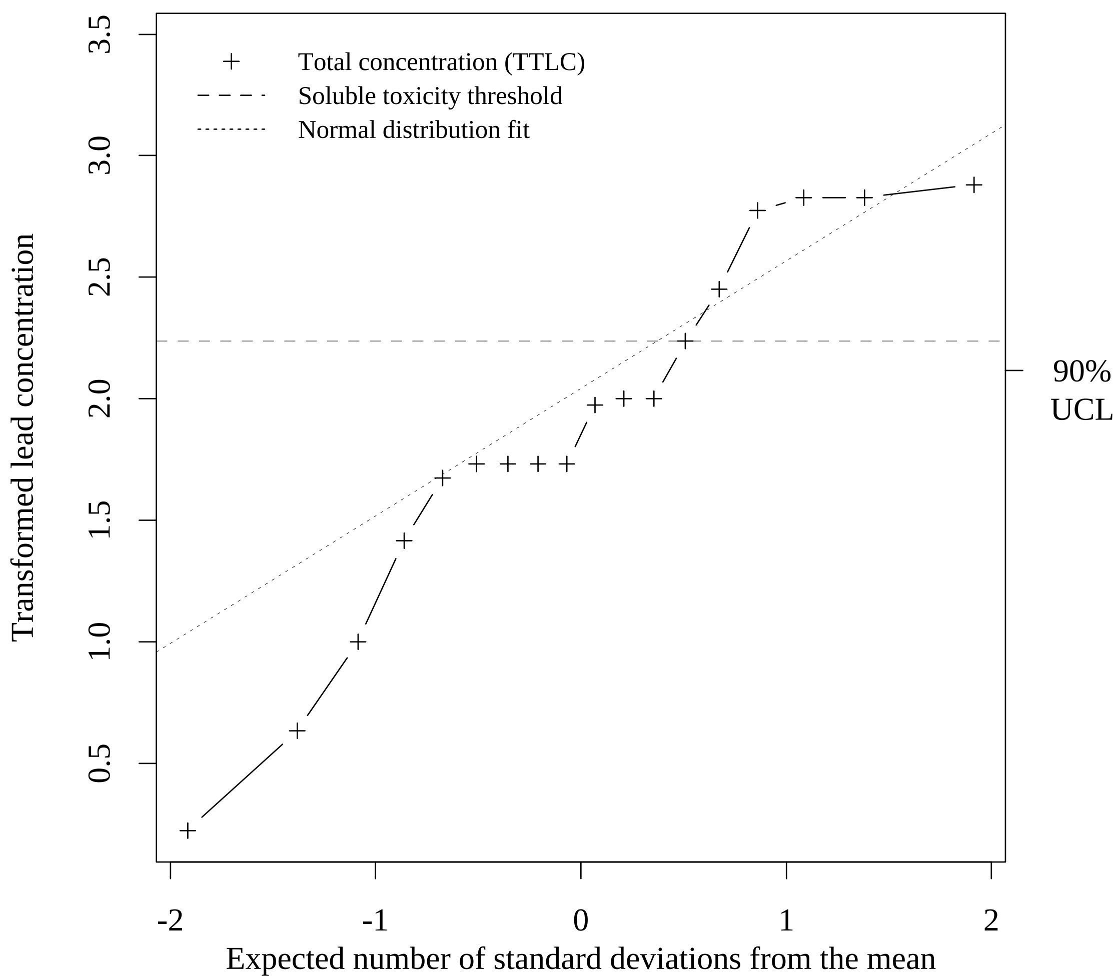

Figure 4.19. Total Lead (TTLC), Square Root Transformation

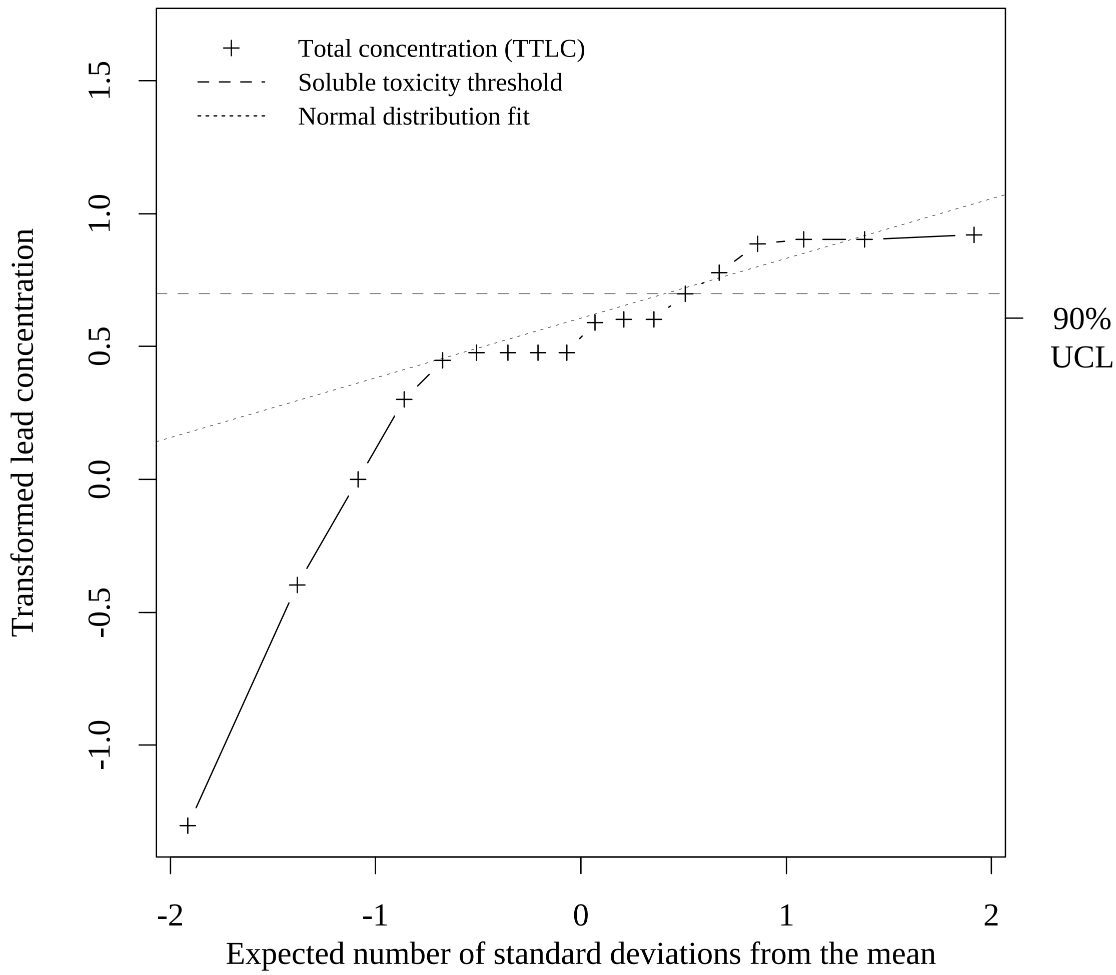

Figure 4.20. Total Lead (TTLC), Log Transformation

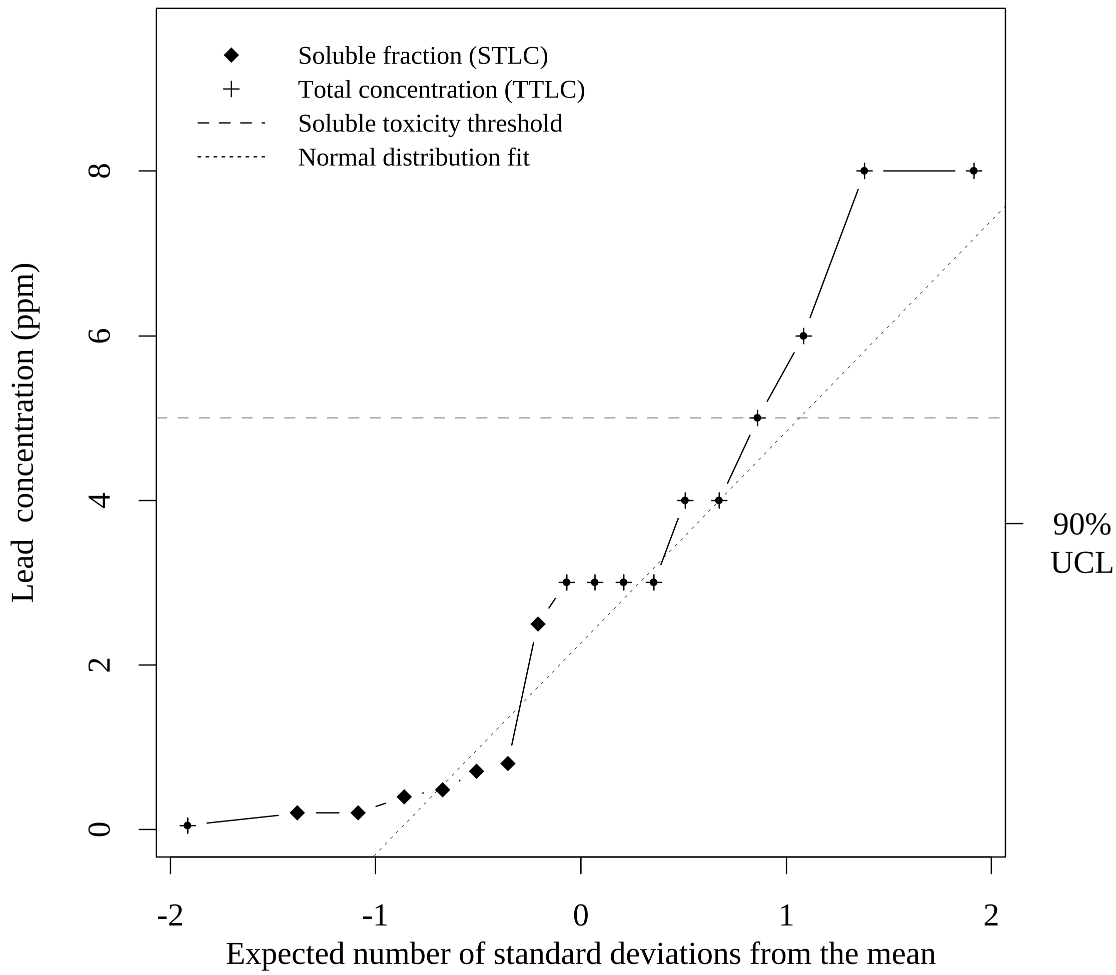

Figure 4.21. Lead Hybrid, Untransformed Data

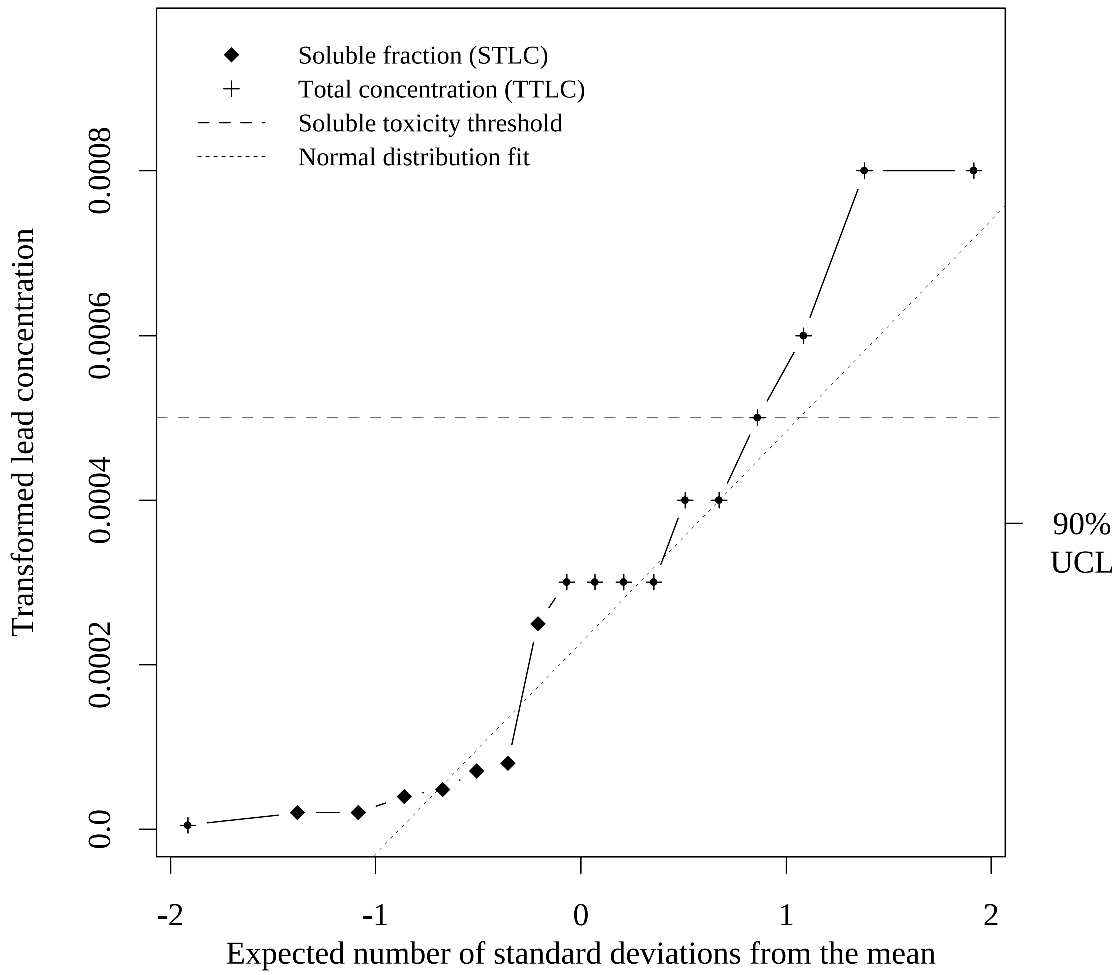

Figure 4.22. Lead Hybrid, Arcsine Transformation

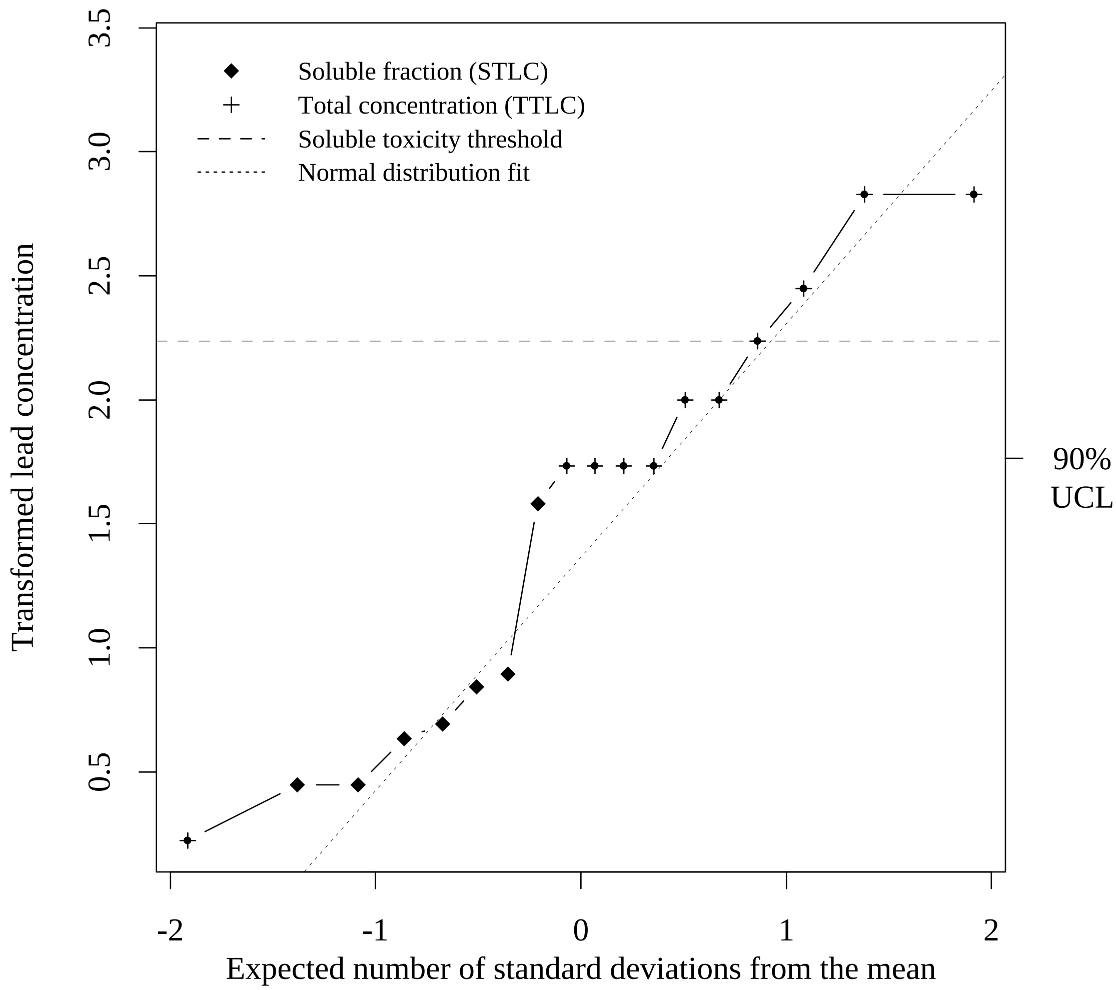

Figure 4.23. Lead Hybrid, Square Root Transformation

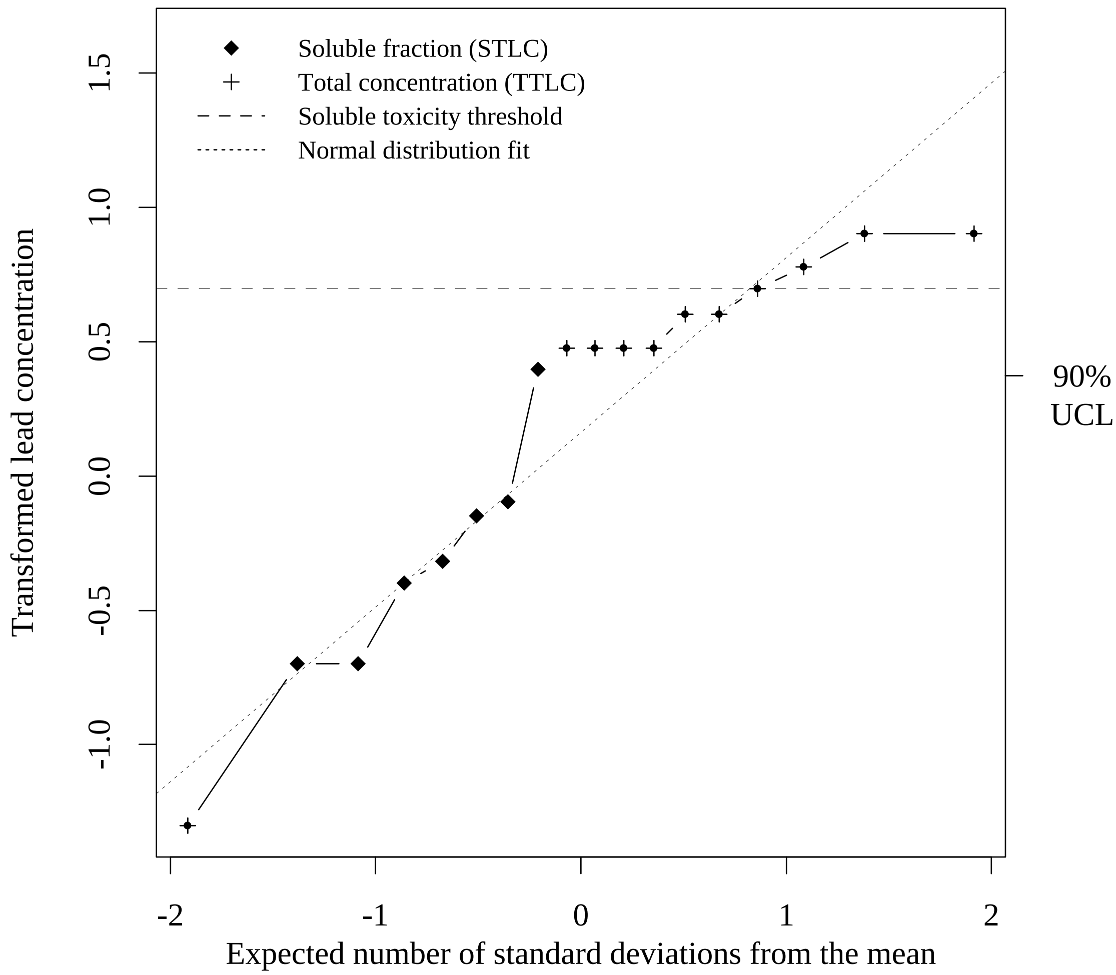

Figure 4.24. Lead Hybrid, Log Transformation

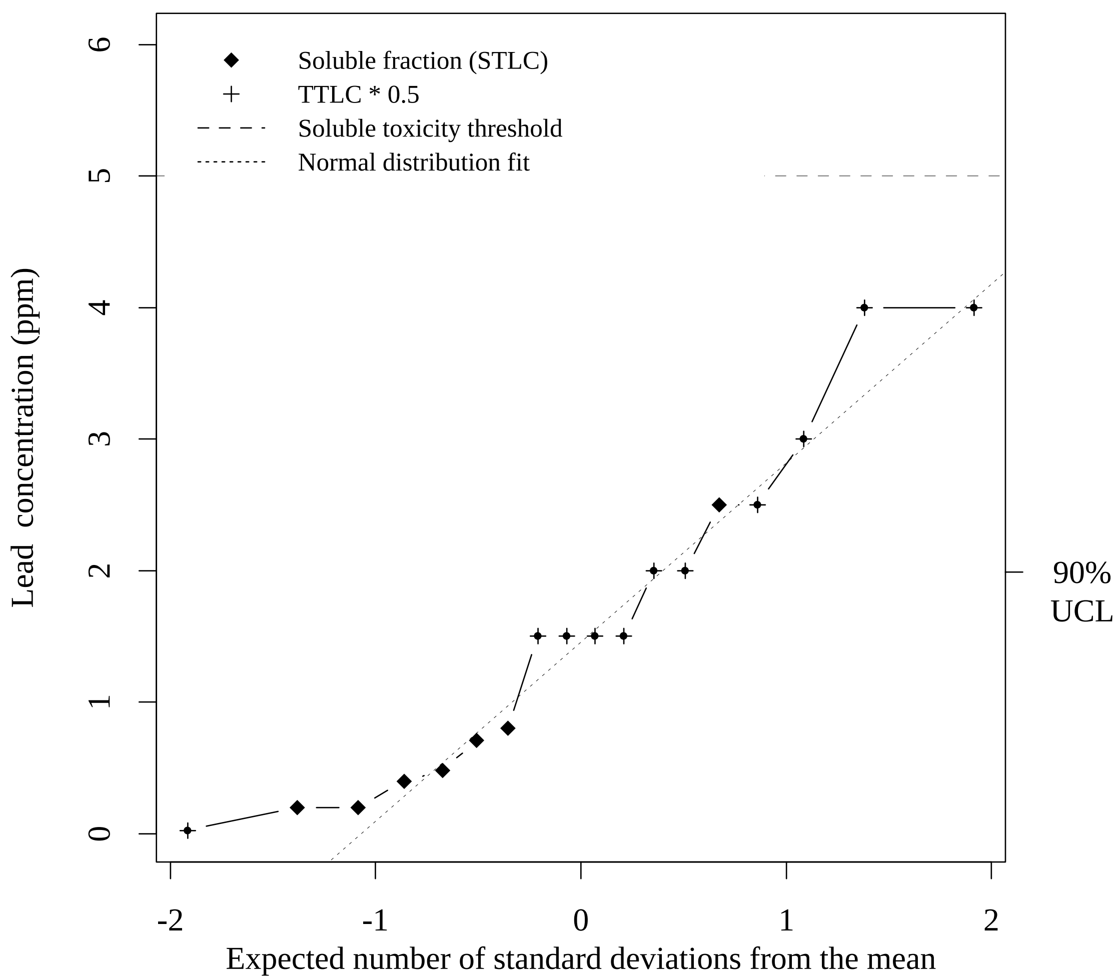

Figure 4.25. Lead Ratio, Untransformed Data

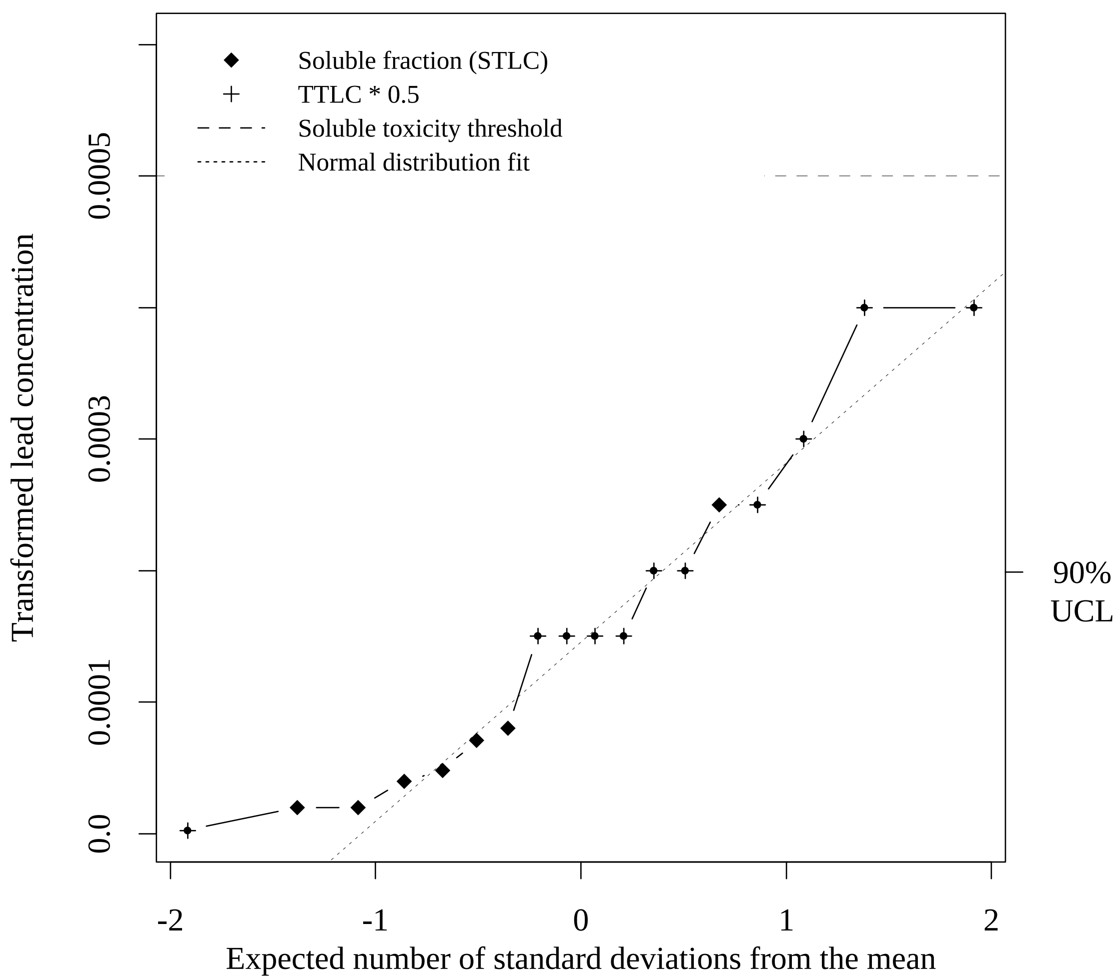

Figure 4.26. Lead Ratio, Arcsine Transformation

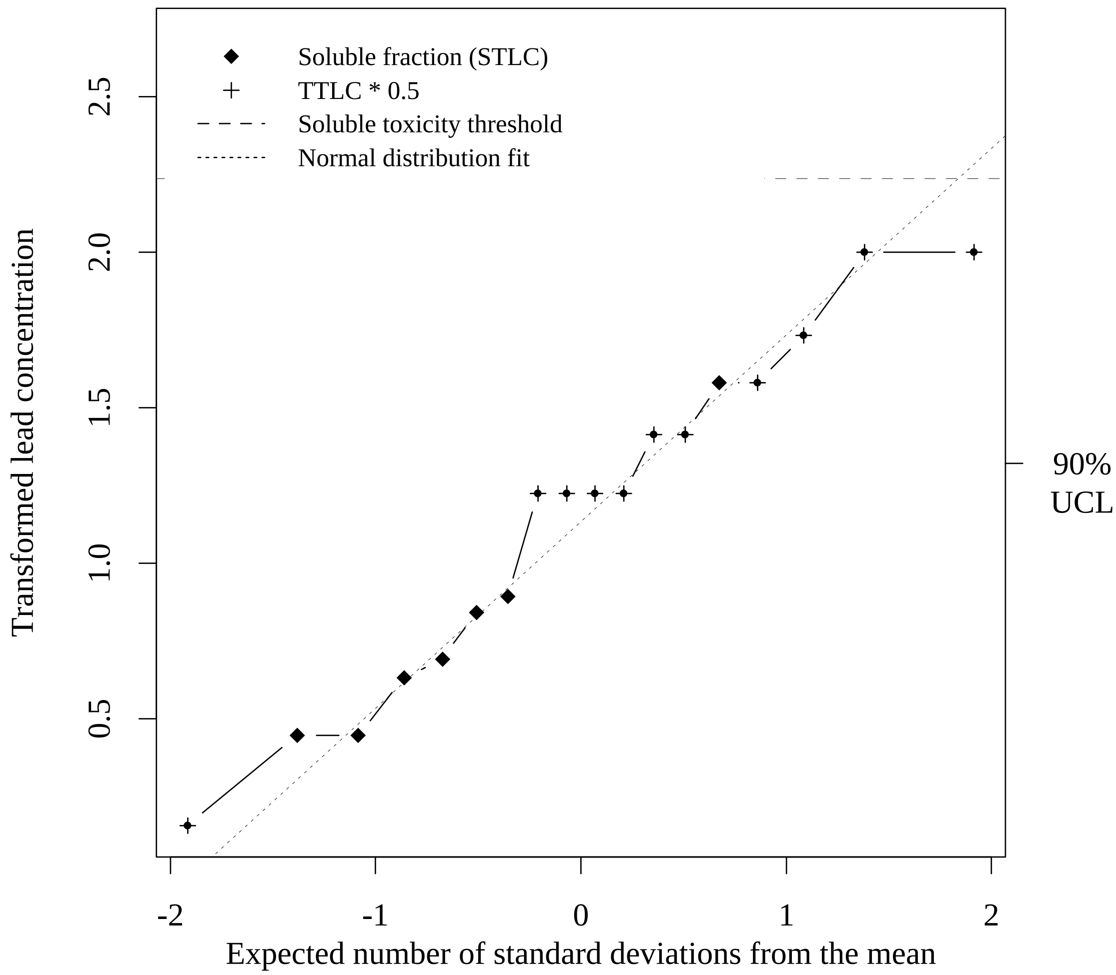

Figure 4.27. Lead Ratio, Square Root Transformation

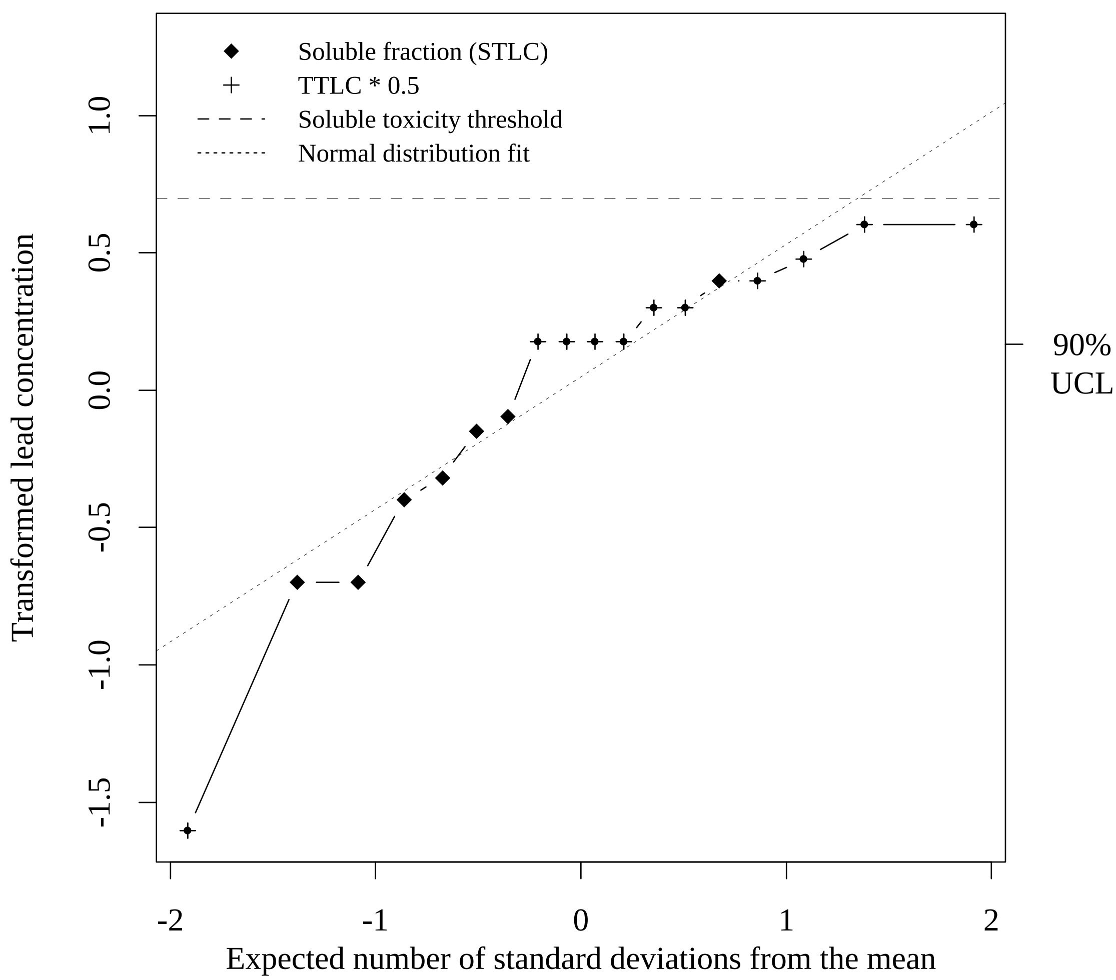

Figure 4.28. Lead Ratio, Log Transformation

Table 4.7. Lead Data Interpretive Chart				
	Normal Distribution	**Arcsine Transform.**	**Square Root Transform.**	**Log Transform.**
TTLC Lead				
Distribution Fit	average	average	below average	below average
90% CI	4.90	0.00049	2.10	0.61
Reg. T.hold	5.00	0.00050	2.20	0.70
90% CI/R.T.	0.98	0.98000	0.95	0.87
Hazardous Determination	no	no	no	no
Validity, Application	**6**	**2**	**1**	**5**
Lead Hybrid				
Distribution Fit	below average	below average	good	very good
90% CI	3.70	0.00037	1.800	0.37
Reg. T.hold	5.00	0.00050	2.200	0.70
90% CI/R.T.	0.74	0.74000	0.818	0.53
Hazardous Determination	no	no	no	no
Validity, Application	**8**	**2**	**5**	**8**
Lead Ratio				
Distribution Fit	average	average	very good	below average
90% CI	2.00	0.0002	1.300	0.17
Reg. T.hold	5.00	0.0005	2.20	0.70
90% CI/R.T.	0.40	0.4000	0.591	0.243
Hazardous Determination	no	no	no	no
Validity, Application	**7**	**1**	**5**	**6**

pH

Evaluation of the tables and plots of the pH data was different than the evaluation of the metals data because only one analytical database was used, and the fact that each of the three transformations of the data had very little impact on the shape of the probability plots. Because only one form of analysis was used to evaluate pH it made it easier to determine if the waste was corrosive or not. The untransformed data, and all of the data transformations showed that their respective 90% upper confidence intervals were below the regulatory threshold even though the three pH results reported as >12.5 were evaluated as having pHs of 14.

In this pH data set the mean, 10.5, is greater than the variance of 3.61, therefore according to SW-846 the untransformed data is the appropriate data for statistical evaluation. However, plotting of the untransformed data and the other data transformations, reveals in every case an abnormal distribution. This situation raises the question of the validity of the non-hazardous determination for pH. Is it possible to make a statistical and regulatory decision that the waste is not hazardous where the database has an abnormal distribution for all data transformations? This question although outside the scope of this research is even more intriguing when each of the data transformations, and the raw data support a decision of non-hazardous.

Table 4.8. pH Data

Sample #	Date	pH
9201026	5/04/92	11.0
9201027	5/04/92	7.0
9201028	5/04/92	10.0
9201399	5/28/92	7.4
9202426	8/25/92	10.28
9202428	8/25/92	10.40
9202429	8/25/92	9.97
9202989	10/20/92	10.66
9202994	10/20/92	10.48
9202995	10/20/92	10.34
9202996	10/20/92	10.20
9202998	10/20/92	10.19
9203000	10/20/92	9.62
9203001	10/20/92	9.70
9300544	2/18/93	14.00
9300545	2/18/93	14.00
9300546	2/18/93	14.00
9400201	1/24/94	10.00

Table 4.9. pH Statistics

	Untrans	Arcsine	Sq. root	Log
mean	10.5	0.001050	3.2	1.02
std. dev.	1.9	0.000190	0.3	0.08
variance	3.61	3.6 E-8	0.1	0.01
SW846CV	0	0.000034	0.03	0.01
coef vr 2	0.18	0.180000	0.09	0.08
U.C.L.	11.1	0.001110	3.32	1.04
t-hold	12.5	0.001300	3.5	1.10
decision	non-haz	non-haz	non-haz	non-haz

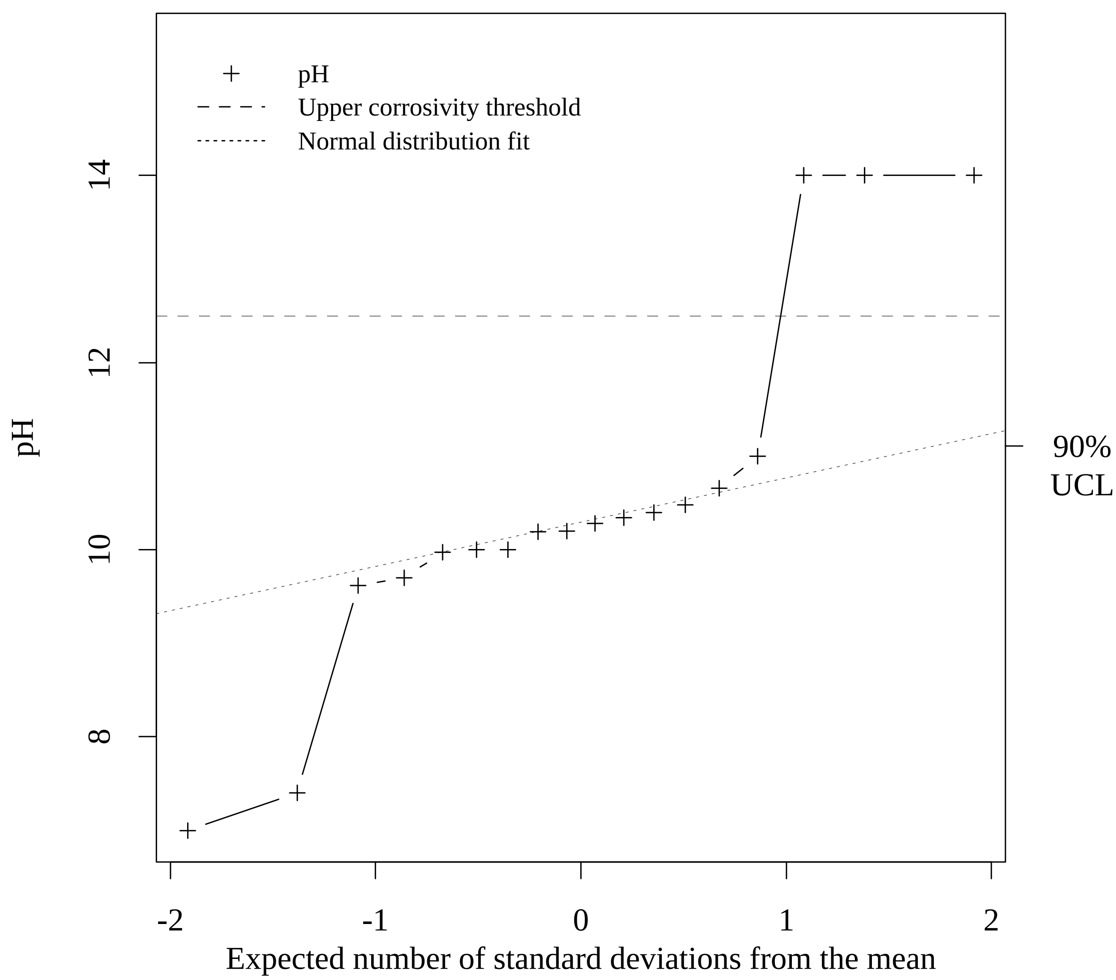

Figure 4.29. pH, Untransformed Data

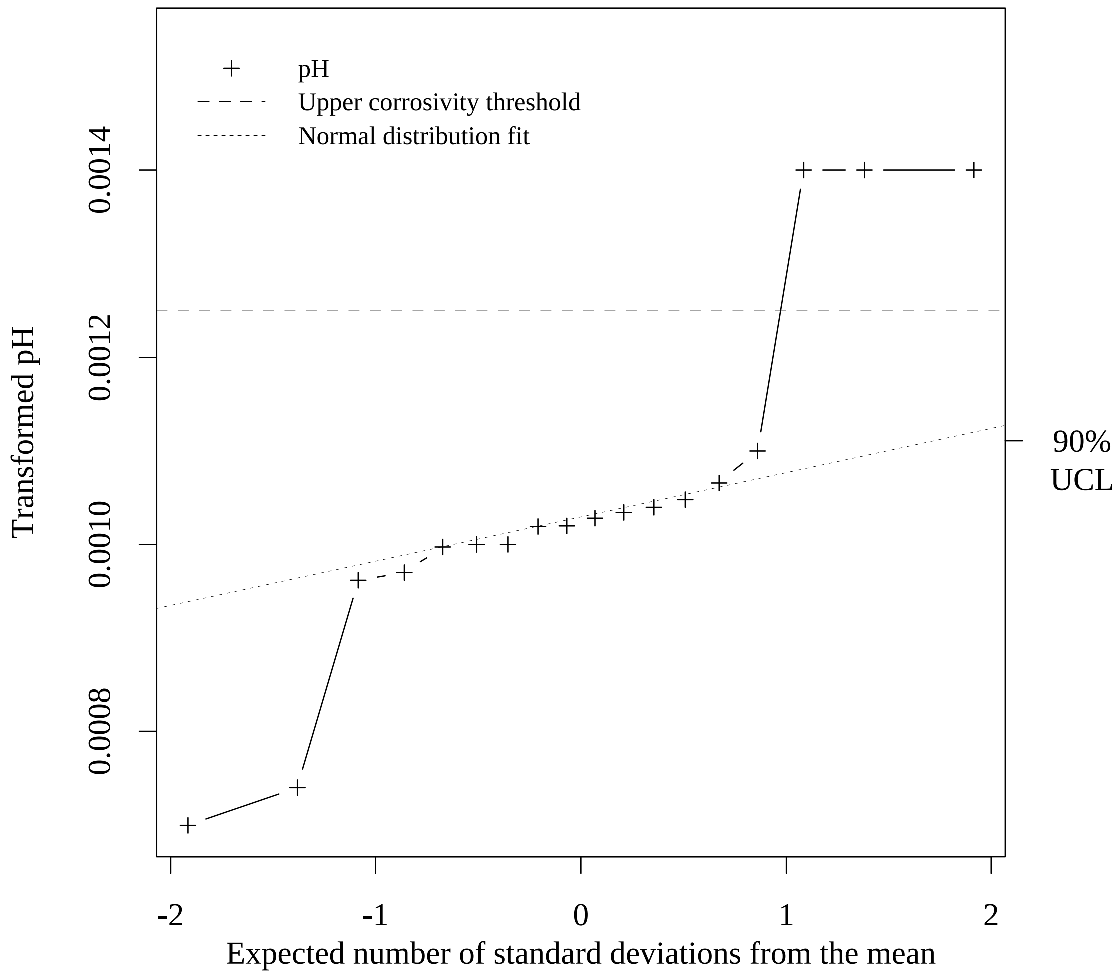

Figure 4.30. pH, Arcsine Transformation

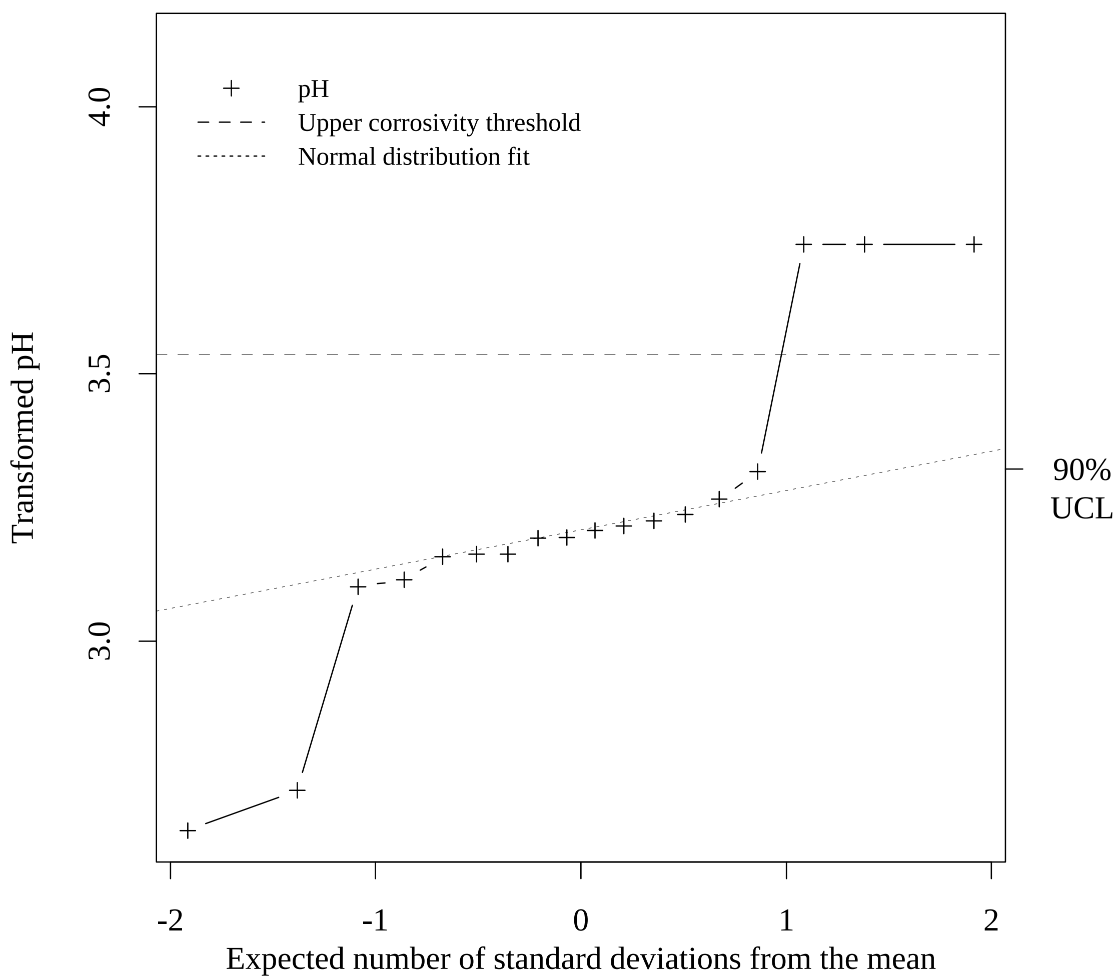

Figure 4.31. pH, Square Root Transformation

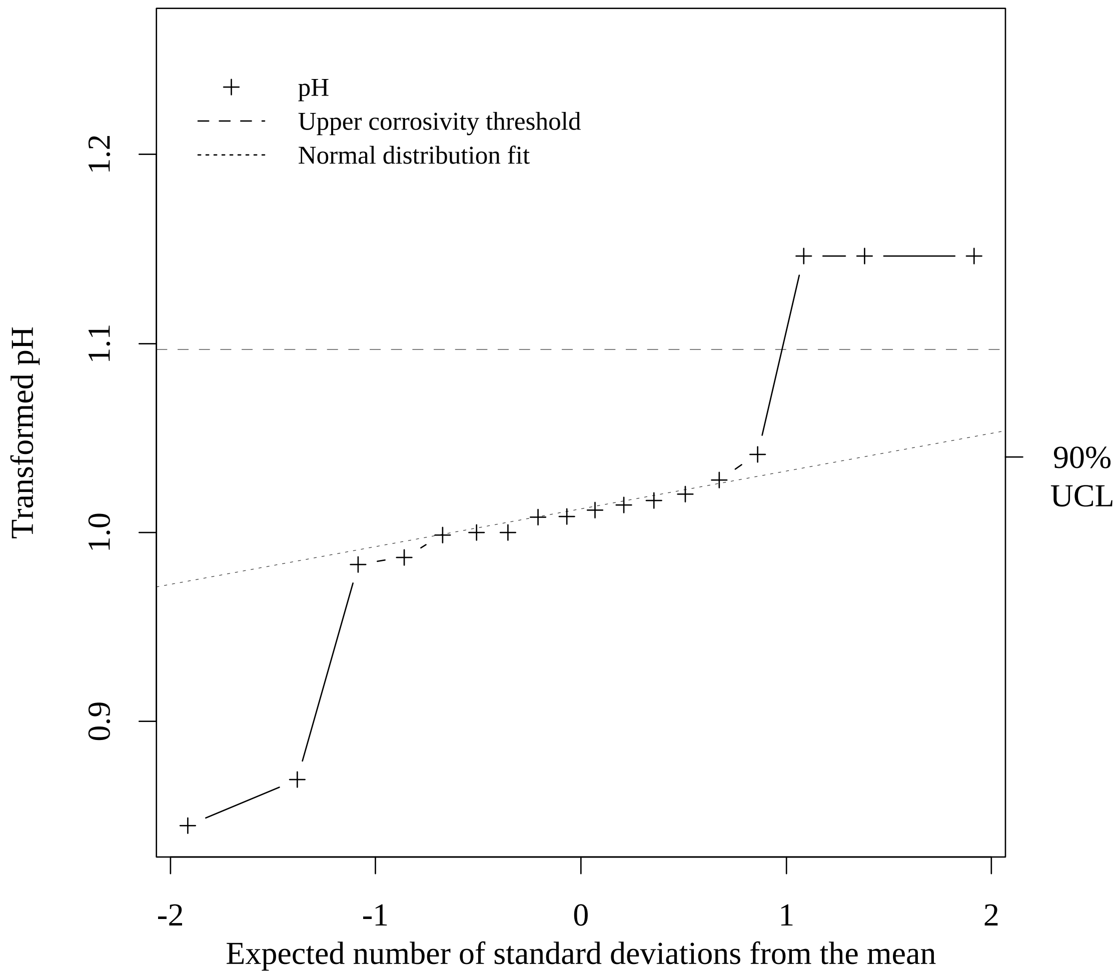

Figure 4.32. pH, Log Transformation

Table 4.10. pH Data Interpretive Chart				
	Normal Distribution	**Arcsine Transformation**	**Square Root Transformation**	**Log Transformation**
pH				
Distribution Fit	below average	below average	below average	below average
90% CI	11.10	0.00111	3.32	1.04
Reg. T.hold	12.50	0.00125	3.50	1.10
90% CI/R.T.	0.888	0.88800	0.95	0.95
Hazardous Determination	no	no	no	no
Validity, Application	**9**	**1**	**1**	**6**

Statistical Analysis Summary

Each of the three waste analytes; zinc, lead and pH have been evaluated independently to determine if either the metals or the pH would be hazardous . The SW-846 General Procedure with different databases of the 18 pieces of data were used in the evaluation of these analytes. In each case, zinc, lead, and pH were not present at hazardous levels for the wastestream as a whole with the exception of the TTLC zinc database.

The application of the TTLC database, STLC hybrid database, and the STLC ratio database to the SW-846 General Procedures is a novel, and unproven method for incorporating, and evaluating TTLC data for comparison with a STLC regulatory threshold. Although these different databases are unproven they do provide additional insight to the distribution and concentrations of the soluble metals in the wastewater. This method of using the STLC data and TTLC data together as one data set can assist the waste generator or regulator in determining if a wastestream is hazardous or not.

In general this research found that the log transformation was the most appropriate transformation for evaluating this wastestream even though this transformation was not addressed in SW-846. It maybe that several different data transformations are applied to a wastewater (analytical database)with a variety of potentially hazardous ingredients, and several of these transformations must be used to obtain the "best fit" to a normal distribution pattern. But from a statistical, and practical stand point it is better to choose a single data transformation that works reasonably well for all contaminants in the waste. Helsel and Hirsh (1992) state in *Statistical Methods in Water Resources* "The tendency to search for the "best" transformation should be avoided. For example, when dealing with several similar data sets, it is probably better to find one transformation which works reasonably well for all, rather than; using slightly different ones for each."

Given the above information, including the interpretive charts, and plots this research makes the following conclusions:

1. Wastewater from floor finish removal at LLNL is not hazardous for zinc, lead or pH.
2. The most appropriate database for evaluation of the metals using the SW-846 General Procedures is the STLC hybrid.
3. The most appropriate data transformation for the analytical data on this wastestream is the logarithmic transformation.

Analysis of the Wastewater as a Toxic Waste

The toxicity data will be broken down into two categories: secondary data acquired from generator knowledge used in combination with material safety data sheets, toxicology reference books; and primary data acquired from analytical analysis of the wastewater at the LLNL facility. This evaluation of waste toxicity will be in relation to the California and Federal toxicity limits as established in 22 CCR.

The secondary data obtained from the Material Safety Data Sheets of the floor finish products: Buckeye Mainstream, Buckeye First Down, Buckeye Straight Up and Buckeye Revelation will provide most of the toxic ingredients to the wastewater as evaluated by Title 22. In contrast, the metals analysis which was the primary concern for the statistical determination of toxicity, contributes only slightly to the cumulative toxicity by the methodology provided within the California regulations.

Dermal Toxicity

Information available on the floor care MSDS sheets indicate that dermal exposure may cause wastewater from floor maintenance to be toxic due to dermal toxicity. Evaluation of the MSDS sheets for the materials used in floor finishing and

Table 4.11. Cumulative Dermal Toxicity						
Primary Constituents	**Chemical In Product**		**Chemical In Waste**		**Derm Tox**	**Wt% / LD50**
	weight %	ppm	weight %	ppm	mg/kg	
Straight Up	100	1000000	0.58	5800	**yes**	
Nonylphenoxypolyethoxy Ethanol	5	50000	0.03	300	2000	0.000015
Coloring and Additives	1	10000	0.00621	62.1		
Cumulative Toxicity						**0.00002**
Revelation (Cumulative tox.)	100	1000000	0.194	1940	**yes**	
Dipropylene Glycol Butyl Ether	25	250000	0.049	490		
Monoethanolamine	15	150000	0.03	300	1000	0.00003
lkyl Benzyl Potassium Sulfonat	5	50000	0.01	100	3200	0.000003
Benzyl Alcohol	5	50000	0.01	100	10000	0.000001
Isononanoic Acid	5	50000	0.01	100		
Perfume coloring & Additives	1	10000	0.002	20		
Cumulative Toxicity						**3.412E-05**
Buckeye Mainstream	100	1000000	25	250000	**no**	
Acrylic Emulsion	37	370000	9.25	92500		
Polyethylene Emulsion	6	60000	1.5	15000		
Acrylate Copolymer	4	40000	1.01	10100	1243	0.000813
Diethylene Glycol Ethyl Ether	2.4	24000	0.594	5940	8500	6.988E-05
Tributoxyethyl Phosphate	2	20000	0.5	5000		
Dipropylene Glycol Methyl Ether	1.8	18000	0.45	4500	9500	4.737E-05
Leveling Agents, Defoamer, Pres	1	10000	0.25	2500		
Cumulative Toxicity						**0.000930**
Buckeye First Down	100	1000000	6.25	62500	**yes**	
Acrylic Emulsion	40	400000	2.51	25100		
*Methyl Alcohol	3.9	39000	0.244	2440	393	0.0006209
Diethylene Glycol Ethyl Ether	3.2	32000	0.2	2000	8500	2.353E-05
Coloring & Additives	1	10000	0.063	630		
Cumulative Toxicity						**0.0006444**
		Sum of Product Toxicities				**0.0016233**
	100 / Sum of Product Toxicities					**61602.315**

Table 4.11. Cumulative Dermal Toxicity p.2							
Metallic Constituents		**Contaminant Concentration In Waste**		**Dermal Toxicity**	**wt.% / LD50**		
		weight %	mg/kg	Metals pose very little dermal toxicity, as can be deduced by the fact that none of the following metals have a dermal toxicity listed in Sax.			
Antimony		0.00166	16.63				
Arsenic		0.00	0.00				
Barium		0.00367	36.74				
Beryllium		0.00001	0.07				
Cadmium		0.00006	0.63				
Chromium		0.00006	0.64				
Cobalt		0.00006	0.62				
Copper		0.00048	4.76				
Lead		0.00048	4.81				
Molybdenum		0.00020	1.97				
Nickel		0.00009	0.93				
Potassium		0.009	90.0				
Selenium		0.00	0.00				
Silver		0.00003	0.25				
Thallium		0.00010	0.98				
Thorium		0.00	0.00				
Uranium		0.003	30.0				
Zinc		0.03111	311.11				
			Cumulative Metallic Toxicity				**0**
	Sum of Constituent and Metallic Toxicities						**0.001623**
	100 Divided by the Sum of Constituent and Metallic Toxicities						**61602.32**
	62508.16>>4300mg/kg. This waste is not a dermal toxin.						

finish removal state that Revelation, First Down, and Straight Up have "skin" listed as a "Route of Entry" under the health hazard section (Buckeye 1993). However the waste generated from the use of these products is much different in composition and concentration from that found in the products before use. By using generator knowledge, the MSDSs, and the reference, Sax's Dangerous Properties of Industrial Materials, an estimate of dermal toxicity of the wastewater can be obtained and evaluated and compared to California law.

This research shows that the cumulative dermal toxicity calculated as per Section 66262.24(c) CCR 22, shows that this waste, although it contains several constituents that have dermal toxicity's listed in Sax, that when the cumulative weight percents of these constituents are calculated, the waste mixture isn't even close to the dermal toxicity threshold of 4300 mg/kg for a 24 hour exposure to a laboratory rabbit. The estimated dermal toxicity for wastewater from floor finishing is estimated at 62508 mg/kg, or nearly 14 times the regulatory threshold.

It's important to note that two chemicals used in the calculation of the cumulative toxicity, acrylate copolymer and the methyl alcohol, compose 90% of the cumulative dermal toxicity (see table 4.11)! These two wax and sealer components are very mobile and volatile, and consequently will dissipate significantly by the time they are placed into a waste container after the floor finish has been removed. More important than the mobility of these materials, is the fact that the toxicity data used to evaluate the acrylate copolymer was taken from the ethyl acrylate monomer. The ethyl and methyl acrylate monomers are much more toxic than the major copolymer used in the wax. According to Dr. Van Eanan (1995) of Buckeye, there are some of these monomers in the product but they are there in "the parts per million range". Therefore, even though the cumulative dermal toxicity is 14 times the regulatory threshold of 4300 mg/kg, the inclusion of the acrylate copolymer and methyl alcohol provides a very conservative - health protective estimate of the dermal toxicity exhibited by this waste.

All of the metals found in this waste stream lack dermal toxicity according to Sax. Therefore this research shows that metals do not contribute significantly to the dermal toxicity of the wastewater. To summarize the dermal toxicity evaluation, this research shows that although three of the floor care products may be pose some dermal toxicity, the resultant wastewater is much less concentrated then the floor care products and is not a hazardous waste based on dermal toxicity.

Ingestion Toxicity

Information available on the floor care MSDSs indicate a waste generated from these Buckeye products may be toxic via ingestion. Under section VI of the MSDS 's for both the cleaners, Revelation, and Straight Up, it indicates that these products are toxic via ingestion. In the wastewater, however, these cleaners make up a small weight percent of the waste because of dilution with water due to normal application, and cleaning methods. In evaluating ingestion toxicity one methodology could eliminate ingestion toxicity based on rat oral LD50 provided for Straight Up, Mainstream, and Revelation. Each of these three products has a LD50 $\geq$ 5010 mg/kg. Therefore the First Down is the only floor care product that may cause the wastewater to be toxic for ingestion. Generator knowledge shows that First Down is present in the waste at an estimated 6.25%. This weight percent of First Down combined with the knowledge of the other products in the waste, indicates that ingestion toxicity is not worthy of evaluation.

Through the application of the formula for calculating cumulative ingestion toxicity in Title 22 it shows that 70% of the ingestion toxicity is contributed by the wax Mainstream, which from the MSDS has a toxicity in the product form above the regulatory threshold.

Table 4.12. Cumulative Ingestion Toxicity							
Primary Constituents		**Chemical In Product**		**Chemical In Waste**		**Ing Tox**	**Wt % / LD50**
		weight %	ppm	weight %	ppm	mg/kg	
Straight Up		100	1000000	0.58	5800	**>5010**	
Nonylphenoxypolyethoxy Ethanol		5	50000	0.03	300	1310	2.2901E-05
Coloring and Additives		1	10000	0.00621	62.1	0	
Cumulative Toxicity							**2.290E-05**
Revelation (Cumulative tox.)		100	1000000	0.194	1940	**5010**	
Dipropylene Glycol Butyl Ether		25	250000	0.049	490	2000	0.00002450
Monoethanolamine		15	150000	0.03	300	1720	1.7442E-05
Alkyl Benzyl Potassium Sulfonate		5	50000	0.01	100	437	2.2883E-05
Benzyl Alcohol		5	50000	0.01	100	1230	8.1301E-06
Isononanoic Acid		5	50000	0.01	100		
Perfume coloring & Additives		1	10000	0.002	20		
Cumulative Toxicity							**7.296E-05**
Buckeye Mainstream		100	1000000	25	250000	**>5010**	
Acrylic Emulsion		37	370000	9.25	92500	0	
Polyethylene Emulsion			60000	1.5	15000	3200	0.00046875
Acrylate Copolymer		4	40000	1.01	10100	3000	0.00033667
Diethylene Glycol Ethyl Ether		2.4	24000	0.594	5940	5500	0.000108
Tributoxyethyl Phosphate		2	20000	0.5	5000	3000	0.00016667
Dipropylene Glycol Methyl Ether		1.8	18000	0.45	4500	5660	7.9505E-05
Leveling Agents, Defoamer, Pres.		1	10000	0.25	2500	0	
Cumulative Toxicity							**0.0011596**
Buckeye First Down		100	1000000	6.25	62500	**unknown**	
Acrylic Emulsion		40	400000	2.51	25100	0	
Methyl Alcohol		3.9	39000	0.244	2440	5628	4.3355E-05
Diethylene Glycol Ethyl Ether		3.2	32000	0.2	2000	5500	3.6364E-05
Coloring & Additives		1	10000	0.063	630	0	
Cumulative Toxicity							**7.972E-05**
			Sum of Product Toxicities				**0.0013352**
			100/sum of rel. toxicity				**74897.226**

Table 4.12. Cumulative Ingestion Toxicity p.2

Metallic Constituents		**Contaminant Concentration in Waste**		**Ingestion Toxicity**	**Wt.% / LD50**		
		weight %	ppm (average)	mg/kg			
Antimony		0.00166	16.63	7000	2.376E-07		
Arsenic		0	0	763	0		
Barium		0.00367	36.74		0		
Beryllium		7E-06	0.07		0		
Cadmium		6.3E-05	0.63	7000	0.00000001		
Chromium		6.4E-05	0.64	71	0.00000090		
Cobalt		6.2E-05	0.62	1500	0.00000004		
Copper		0.00048	4.76	152	0.00000313		
Lead		0.00048	4.81	100	0.00000481		
Molybdenum		0.0002	1.97	448	4.3973E-07		
Nickel		9.3E-05	0.93	5000	1.86E-08		
Potassium		0.009	90		0		
Selenium		0	0		0		
Silver		2.5E-05	0.25		0		
Thallium		9.8E-05	0.98		0		
Thorium		0	0		0		
Uranium		0.003	30		0		
Zinc		0.03111	311.11		0		
	Cumulative Metallic Toxicity				**9.59E-06**		
	100 Divided by Sum of Metallic Toxicants				**10428372.2**		
100 Divided by the Sum of Constituent and Metallic Toxicants					**74363.15**		
74363 mg/kg >> 5000mg/kg. This waste is not toxic by ingestion.							

When the cumulative ingestion toxicity is calculated by the formula in CCR 22 Section 66261.24(c) the acute (toxicity) LD_{50} is 74,287 mg/kg, much greater than the 5000 mg/kg regulatory threshold. Again this calculated ingestion toxicity is health protective because of the inclusion of the toxicity data for methyl acrylate (in lieu of data specific to acrylate copolymer), and the toxicity data for methyl alcohol. The methyl alcohol constituent, from the First Down, floor sealer has surely volatalized to less than 10 percent of it's original concentration by the time it becomes a waste component.

The metal constituents introduced to the wastestream from sources other than floor care products account for about 1% of the cumulative ingestion toxicity (see table 4.12.). This fact is interesting because the metals, particularly zinc, has occasionally required this waste to be managed as hazardous because of its concentration has exceeded the regulatory threshold, yet for cumulative toxicity the metals are relatively unimportant. Zinc doesn't even have an LD_{50} published in Sax indicating that zinc is primarily an environmental toxin, and is much more toxic to plants (mandarin seedlings),and invertebrates (clams) than it is to vertebrates, including man (McKee, Wolf 1963).

The detection limits used in the laboratory analysis of the metal analytes also contributes to the estimate of the ingestion toxicity. This study utilizes the detection limit, as the actual value in determining toxicity, where the analysis was at or below the level of sensitivity of the laboratory equipment. For ingestion toxicity 26 percent of the ingestion toxicity burden was contributed by metal analysis where results were at or below the detection levels of the analytical equipment. Conservatively then, the estimated metal toxicity is ten to fifteen percent lower than that calculated in Table 4.12.

The cumulative ingestion toxicity of the metals and product constituents from wastewater from floor finishing, and floor finish removal is 14 times that of the regulatory threshold of 5000 mg/kg. The relative dermal toxicity and ingestion toxicity of this wastewater is virtually identical, both having estimated cumulative $LD_{50}s \approx 14.5$ times their respective regulatory thresholds.

Inhalation Toxicity

The regulatory determination of the acute inhalation toxicity is different from that of dermal toxicity and the oral toxicity because there isn't a method which allows for the cumulative inhalation toxicity to be determined in the California hazardous waste regulations. This is interesting because both the *California Assessment Manual,* (1981) and recent guidance in the CAL-EPA Guidance Document *Waste Classification Regulation Guidance Manual* (1994) state that inhalation toxicity can be evaluated cumulatively. California regulations however take a different approach in determining inhalation toxicity. For a waste to be an inhalation hazard the waste must meet all of the following criteria:

1. The material of concern must be either a gas or a vapor.
2. The constituent of concern in the waste must have a lethal dose (as determined by the rat LC_{50} for an 8 hour continuos exposure) of l0,000 ppm or less.
3. When analyzed by EPA method 5020 the contaminant must be present in excess of it's specific LC_{50} concentration.

In evaluating the wastewater from floor finish removal for inhalation toxicity this research generated an interpretive chart after the fashion of the dermal, and ingestion charts, for the sake of providing additional information in evaluating inhalation toxicity. It is understood that this information can be used to aide the waste generator in evaluating inhalation toxicity, not in making the regulatory determination of toxicity. In examining the inhalation toxicity of this wastestream it is assumed that all metals found in the historical analysis are present in particulate form in an aqueous solution (waste), and therefore are not considered to pose an inhalation hazard.

Table 4.13. Cumulative Inhalation Toxicity							
Primary Constituents		**Chemical in Product**		**Chemical In Waste**		**Inhal. Tox.**	**Wt. % / LC50**
		weight %	ppm	weight %	ppm	no	
Straight Up		100	1000000	0.58	5800		
Nonylphenoxypolyethoxy Ethanol		5	50000	0.03	300		
Coloring and Additives		1	10000	0.00621	62.1		
Cumulative Toxicity							**0**
Revelation (Cumulative tox.)		100	1000000	0.194	1940	no	
Dipropylene Glycol Butyl Ether		25	250000	0.049	490		0
Monoethanolamine		15	150000	0.03	300		0
Alkyl Benzyl Potassium Sulfonate		5	50000	0.01	100		0
Benzyl Alcohol		5	50000	0.01	100	2000	0.000005
Isononanoic Acid		5	50000	0.01	100		0
Perfume coloring & Additives		1	10000	0.002	20		0
Cumulative Toxicity							0.000005
Buckeye Mainstream		100	1000000	25	250000	no	
Acrylic Emulsion		37	370000	9.25	92500		
Polyethylene Emulsion			60000	1.5	15000		0
Acrylate Copolymer		4	40000	1.01	10100	1350	0.000748148
Diethylene Glycol Ethyl Ether		2.4	24000	0.594	5940		0
Tributoxyethyl Phosphate		2	20000	0.5	5000		0
Dipropylene Glycol Methyl Ether		1.8	18000	0.45	4500		0
Leveling Agents, Defoamer, Pres.		1	10000	0.25	2500		
Cumulative Toxicity							**0.0007481**
Buckeye First Down		100	1000000	6.25	62500	no	
Acrylic Emulsion		40	400000	2.51	25100		
Methyl Alcohol		3.9	39000	0.244	2440	64000	3.8125E-06
Diethylene Glycol Ethyl Ether		3.2	32000	0.2	2000		0
Coloring & Additives		1	10000	0.063	630		
Cumulative Toxicity							**3.813E-06**
			Sum of Product Toxicities				**0.0007570**
			100/sum of rel. toxicity				**132107.26**

Table 4.13. Cumulative Inhalation Toxicity							
Primary Constituents		**Chemical in Product**		**Chemical In Waste**		**Inhal. Tox.**	**Wt. % / LC50**
		weight %	ppm	weight %	ppm	no	
Straight Up		100	1000000	0.58	5800		
Nonylphenoxypolyethoxy Ethanol		5	50000	0.03	300		
Coloring and Additives		1	10000	0.00621	62.1		
Cumulative Toxicity							**0**
Revelation (Cumulative tox.)		100	1000000	0.194	1940	no	
Dipropylene Glycol Butyl Ether		25	250000	0.049	490		0
Monoethanolamine		15	150000	0.03	300		0
Alkyl Benzyl Potassium Sulfonate		5	50000	0.01	100		0
Benzyl Alcohol		5	50000	0.01	100	2000	0.000005
Isononanoic Acid		5	50000	0.01	100		0
Perfume coloring & Additives		1	10000	0.002	20		0
Cumulative Toxicity							0.000005
Buckeye Mainstream		100	1000000	25	250000	no	
Acrylic Emulsion		37	370000	9.25	92500		
Polyethylene Emulsion			60000	1.5	15000		0
Acrylate Copolymer		4	40000	1.01	10100	1350	0.000748148
Diethylene Glycol Ethyl Ether		2.4	24000	0.594	5940		0
Tributoxyethyl Phosphate		2	20000	0.5	5000		0
Dipropylene Glycol Methyl Ether		1.8	18000	0.45	4500		0
Leveling Agents, Defoamer, Pres.		1	10000	0.25	2500		
Cumulative Toxicity							**0.0007481**
Buckeye First Down		100	1000000	6.25	62500	no	
Acrylic Emulsion		40	400000	2.51	25100		
Methyl Alcohol		3.9	39000	0.244	2440	64000	3.8125E-06
Diethylene Glycol Ethyl Ether		3.2	32000	0.2	2000		0
Coloring & Additives		1	10000	0.063	630		
Cumulative Toxicity							**3.813E-06**
			Sum of Product Toxicities				**0.0007570**
			100/sum of rel. toxicity				**132107.26**

Table 4.13. Cumulative Inhalation Toxicity p.2

Metallic Constituents		Contaminant In Waste		Inhal'n Toxicity	Wt.% / LC50		
		weight %	ppm (average)				
Antimony		0.00166	16.63	0	0		
Arsenic			0		0		
Barium		0.00367	36.74		0		
Beryllium		0.00001	0.07		0		
Cadmium		0.00006	0.63	25	0.000003		
Chromium		0.00006	0.64		0		
Cobalt		0.00006	0.62		0		
Copper		0.00048	4.76		0		
Lead		0.00048	4.81	0.01	0.0481		
Molybdenum		0.00020	1.97		0		
Nickel		0.00009	0.93		0		
Potassium		0.009	90		0		
Selenium			0		0		
Silver			0		0		
Thallium			0		0		
Thorium			0		0		
Uranium			0		0		
Zinc		0.031111	311.11		0		
		Cumulative Metallic Toxicity.			**0.0481**		
	100 Divided by Sum of Metallic Toxicants.				**2078.89**		
100 Divided by the Sum of Constituent and Metallic Toxicities.					**2046.69**		
2046.69 ppm < 10000 ppm indicating waste is potentially toxic via inhalation.							

Table 4.14. Dermal Toxicity: Ranking of Toxicity by Constituent

Chemical	Source	Toxicity Ratio	% of Cum Tox
acrylate copolymer	Mainstream	8.13E-4	50.1
methyl alcohol	First Down	6.21E-4	38.2
DGEE	Mainstream	9.34E-5	5.8
DGME	Mainstream	4.74E-5	2.9
monoethanolamine	Revelation	3.00E-5	1.8
Non. ethanol	Straight Up	1.50E-5	.9
ABPS	Revelation	3.13E-6	00.2
benzyl Alcohol	Revelation	1.00E-6	00.06
Total Metals	Waste Analysis	0.00	00.0
Total		1.62E-3	99.96

Table 4.15. Ingestion Toxicity: Ranking of Toxicity by Constituent

Chemical	Source	Toxicity Ratio	% of Cum Tox
acrylate copolymer	Mainstream	3.40E-4	38.83
T. phosphate	Mainstream	1.70E-4	19.42
DGEE	Mainstream & First Down	1.44E-4	16.45
DGME	Mainstream	8.00E-5	9.14
polyethylene emlsn.	Mainstream	4.69E-5	5.36
methyl alcohol	First Down	4.34E-5	4.96
ABPS	Revelation	2.29E-5	2.62
monoethanolamine	Revelation	1.74E-5	1.99
Total Metals	Waste Analysis	1.10E-5	1.26
Total		8.76E-4	100.03

Table 4.16. Inhalation Toxicity: Ranking of Toxicity by Constituent

Chemical	Source	Toxicity Ratio	% of Cum Tox
acrylate copolymer	Mainstream	7.48E-4	98.94
benzyl Alcohol	Revelation	5.00E-6	00.66
Methyl Alcohol	First Down	3.81E-6	00.05
Metals do not apply because they are in particulate form.			00.00
Total		7.56E-4	99.65

With the elimination of the metals in the evaluation of inhalation toxicity, there are only three chemicals (benzyl alcohol, methyl alcohol, and acrylate copolymer) for which inhalation toxicity data could be obtained in commonly used toxicity references. Methyl alcohol has an LC_{50} of 64000 ppm, which is greater than 10,000 ppm, so by regulation it can not contribute to the inhalation toxicity. Benzyl alcohol, and the acrylate copolymer however have LC_{50}s less than 10,000 ppm.

The toxicity of the benzyl alcohol will be evaluated using a method commonly used by industrial hygienists (Ochi 1995), that is by determining the partial pressure of benzyl alcohol, and assuming that the entire wastewater is actually 100% benzyl alcohol. The vapor pressure of benzyl alcohol, under standard conditions is 0.15 mm of mercury . By dividing this vapor pressure by one standard atmosphere it is determined that less than 200 ppm of benzyl alcohol will be released to the atmosphere; well below the specific LC_{50} of 2000 ppm for benzyl alcohol. The maximum airborne concentration of benzyl alcohol at standard temperature, and pressure,

$$= \frac{.15 \text{ mm Hg}}{760 \text{ mm Hg}} = 1.97\text{E-4 or } 197 \text{ ppm benzyl alcohol.}$$

Therefore, even with the assumption that wastewater from floor finish removal is pure benzyl alcohol, this material does not pose a toxic inhalation hazard.

Acrylate copolymer is the only other material which may pose toxic levels by inhalation. Again this research shows this material to have an inflated inhalation toxicity because of the use of the methyl acrylate monomer for the source of the toxicity data. In reality, the amount of methyl acrylate, or ethyl acrylate is much reduced in the floor finish Mainstream. Dr. Van Eanan of Buckeye stated that the acrylate monomers released in this wastestream is similar that generated from latex paint (Van Eanan 1995). From this information this research concludes that the acrylate copolymer is not present at a level to cause the waste to be toxic via inhalation.

Using the methods available to determine cumulative inhalation toxicity after the fashion of ingestion toxicity, the benzyl alcohol, methyl alcohol, acrylate copolymer and metal constituents in wastewater from floor finish removal operations do not appear to pose a toxic inhalation hazard. This cumulative toxicity information can be considered as supporting information, or process knowledge in evaluating the inhalation toxicity. To conclusively state that this wastestream is not an inhalation hazard this wastewater must be analyzed by EPA method 5020 and the headspace gas concentrations for materials with rat LC_{50} of less than 10,000 ppm must be evaluated individually where at least one of the gases fell below it's toxicity threshold.

Acute Aquatic Toxicity

Evaluation of wastewater from floor finish removal using the acute fish toxicity test was performed only once. However, the value of this test provides considerable evidence in supporting a classification of the waste as non-hazardous. This test is important for several reasons.

The container which was sampled for fish toxicity was a 5000 gallon tanker holding 2150 gallons of wastewater from floor finish removal (see appendix I). When obtaining a representative sample of such a large container, LLNL protocol requires circulation of the entire volume of this waste thoroughly. Therefore it is much easier to obtain a representative sample of this wastestream than with other sampling techniques, such as a COLIWASA, where sludge in the bottom of the drum may be missed. In 50% of the 55 gallon drums (nine containers) sampled with a COLIWASA the average TTLC zinc concentration was 66 mg/kg; only 35% of the TTLC concentration found in the 5000 gallon tanker. See sample numbers: 9201026, 9201027, 9201028, 9201399,9202426, 9202428, 9300544, 9300545, 9400201 (Table 4.2).

Another important fact illustrated by the fish bioassay, is that none of the fish died at twice the LC50 concentration of 500 mg/kg, required for a positive toxicity test.

Perhaps the most important information regarding this acute toxicity test is that it was completed concurrently with TTLC metals and STLC metals analysis. This allows for a comparison of the metal concentrations found in the other containers, and to extrapolate probable fish toxicity. From the following table it is clear that based on the metals analysis, and the knowledge that the waste generation practice (with the use of a non-zinc products) that the fish bioassay should conservatively represent the waste currently being generated.

Although the lead and zinc concentrations from the analysis of the 55 gallon drums are above the concentrations found during the acute aquatic toxicity test; the knowledge that none of the fish died at twice the LC_{50} concentration, indicates that the waste currently being generated from floor finish removal is probably not toxic via acute aquatic toxicity.

Table 4.17. Contaminant Concentrations: Fish Bioassay

Contaminants	Fish Bioassay Results		55 gallon Drums Average Concentration	
Metals (ppm)	STLC	TTLC	STLC	TTLC
Zinc	99	190	255	312
Lead	2	5	1	4
pH	10.5		10.5	

Chronic Toxicity

In evaluating chronic toxicity of wastewater from floor finish removal, all known constituents with their concentrations in the waste (based on process knowledge, MSDS sheets and historical analytical) are compared with the materials in California known to exhibit the characteristic of chronic toxicity. This list is found in Section 66261.24.(a)(7). There are 16 chemicals on this chronic toxicity list, none of which are known to be in the wastewater from floor finish removal. Consequently wastewater from floor finish removal does not exhibit the characteristic of chronic toxicity under California regulation.

Analysis of Wastewater Storage Containers

The third research problem of this thesis addresses Lawrence Livermore National Laboratory's, Hazardous Waste Management Division's on site container storage of wastewater from floor finish removal.

The storage methodology does depend to some degree on the classification of the waste as hazardous or not. This research has shown that by the SW-846 statistical evaluation and through evaluation of the different California toxicity criteria that this wastewater is neither toxic or corrosive, and is therefore not a hazardous waste if the wastewater is understood to be a "wastestream", where it can be assumed that all containers of wastewater from floor stripping have been generated by like processes and have average characteristics that indicate that this waste is not hazardous. What happens when this non-hazardous wastestream is analyzed and a particular container is found to be hazardous? For the purpose of evaluating the containers, and storage of wastewater it will be assumed that their is a potential that a container of wastewater is hazardous and therefore must be stored occasionally in a hazardous waste, Waste Accumulation Area (WAA) on the Lab site.

Regardless of the classification of the waste, for liability reasons it may be a best management practice to store containers of this wastewater in a WAA.

The LLNL permit with CAL-EPA states that when a hazardous waste container is filled, it must be moved into a permitted Waste Accumulation Area within three days. Given the following assumptions for wastewater from floor finishing:

1. An annual volume of 6000 gallons.
2. Potential classification as a hazardous waste.
3. 250 workdays per year.
4. Management in 55 gallon containers.

this waste must be moved in to a WAA twice each week, to keep up with the relatively large volume. This transfer of the wastewater in drums from the point of accumulation is a time consuming and labor intensive task.

Due to the large volume of wastewater from floor finish removal, a reasonable alternative to managing this waste in drums, would be to accumulate the waste in a larger container, a portable tank, while in the WAA. A portable tank, regulated as a container by DOT and DTSC, is a container commonly having a volume of 300 gallons or more, which is adapted so it can be transported via forklift, or truck (with a trailer hitch) on LLNL roads.

One significant problem to the storage of portable containers in a waste accumulation area is that these portable tanks require secondary containment, and only two WAAs (WAA 169, and WAA 495) on the LLNL site have the capacity to secondarily contain portable tank volumes of hazardous waste.

The Custodial staff within the Plant Engineering Directorate has one primary WAA where wastewater from floor finishing can be stored, the B-511 WAA. This WAA does not meet the current management policy requiring a secondary containment system, or a berm capable of holding 100% of the volume of the largest portable container. Although this secondary containment of portable tanks of hazardous waste is a LLNL policy, it is within the California hazardous waste regulations to accumulate, and store this wastewater in a portable container while in the WAA.

There are a variety of portable tanks used on the LLNL site by the Hazardous Waste Management Division. Based strictly on the number of portable tanks available to HWM, the most common portable tanks used include: 330 gallon polyethylene tank (tuff tank), 660 gallon polyethylene (poly) tank; 625 gallon stainless steel(s.s.) tank and a 750 gallon s.s. tank. Another portable tank used on site is the 500 gallon polyethylene globe mounted on a trailer. This research will evaluate these portable containers, in addition to the 55 gallon closed top steel drum, in order to determine which one of them is most appropriate to store wastewater from hard surface floor maintenance operations.

These portable containers are used by several groups of LLNL employees. These groups of employees include: the Hazardous Waste Management Field Technicians, HWM Liquid Waste Treatment Technicians, and the Environmental Restoration Division (ERD)Technicians. These three groups of people completed the questionnaire on tank use to determine which container(s) were the best for their particular application and why (See appendices J and K).

It's important to note, that although all three of these groups of LLNL employees use portable tanks, the HWM staff do not have access to the poly globes used by the ERD techs, and the ERD techs use the poly globes almost exclusively.

Portable Containers

The 55 gallon steel drum is currently used to store wastewater from floor finish removal when it is being collected and stored outside of the main Hazardous Waste Management Facility, the 612 Complex. The steel drum used is the standard 55 gallon drum, which meets the 17E standards established by DOT. Specifically the drum used, is one which originally stores the product wax used in floor finishing. This container has a typical arrangement of a 2" bung, and a 3/4" vent (bung) located opposite each other on the top. The sides of the drum have two areas which are expanded slightly allowing for easier lifting using drum transfer equipment, a "drum grabber".

The 330 gallon "Tuff Tank" is the smallest of the five tanks evaluated. It is a nearly square polyurethane tank standing 5' tall, measuring 4' on each side. This opaque poly tank rests on a separate poly foundation within a protective metal cage.

This poly tank (bladder) is the simplest of all containers in that it has only 2 ports; an 8" fitting at the top of the tank. and a 2" poly fitting at the bottom for draining the tank.

The inlet fitting on the top of the tank has a plastic cap with large threads and a built in neoprene O ring for insuring a water tight seal. The bottom of the tank is sloped to the plastic drain line. This drain line has a ball valve closure, ending in a 2" female "quick connect" cam lock fitting.

The metal cage surrounds all surfaces of the tuff tank except for the top. The cage design of criss-cross steel rods on 2" centers protects the poly tank from damage during transportation, or puncture from a forklift. The valve is also very well protected, it is recessed under the tank and covered by an 1/8" metal plate on a hinge, which is lifted during operation. The base of the metal cage rests on metal struts which have been modified with a plastic base to prevent damage to the painted berms where these tanks are frequently stored. This tuff tank has heavy duty built in brackets on the bottom of the metal cage which allows for forklift transport.

This 330 gallon tuff tank, when purchased, met DOT-E 9052 requirements.

660 gallon polyurethane tank. This cylindrical opaque poly tank rests horizontally on a steel cradle adapted for forklift transport. The tank on the cradle has an overall length of 7'6" and a height of 6'. The outside diameter of the tank is 4'. Together with the cradle tie down straps this tank is 4'6" wide. This poly 660 gallon tank has three openings: a 10" screw-top lid to a central opening on the top; a threaded 3" fitting into the reinforced, raised area adapted for the installation of lifting lugs at the top of the tank, and a 2" recessed poly fitting located at the bottom of the tank near one end. The 10" fitting at the top of the tank is used to add liquid to the tank. This 10" fitting has a cap with very large threads which can be removed by hand. The threaded cap, in conjunction with a separate pliable plastic pancake style gasket, seals the tank. The 3" threaded bung has been adapted to handle a 2" threaded hose, or cam lock adapter. The drain valve located at the bottom of one end of the tank has a ball valve and a male camlock end. This valve

is recessed under the tank and is protected from damage by a steel guard. This portable container was constructed to meet DOT E 8839 specifications.

625 gallon stainless steel tank. This tank has an over all length of 8' and a height of 5' 6". This 4' diameter cylindrical tank rests in a metal cradle adapted for transportation by fork lift. This tank, like the 660 poly tank has 3 valves; an 18" manway centrally located on the top; a short, top mounted, guarded, 2" short stainless steel fill line adapted with a female 2" cam fitting at the end; and a guarded, recessed, 2" drain, with a ball valve and female cam fitting. The 18" manway at the top of the tank is sealed by a stainless steel hinged lid which is secured with a large locking single action cam, and 6 small cam locks which secure the lid to the tank. This stainless steel lid weighing about 15 pounds, has a built in gasket which is secured by a metal flange. This portable container is mounted on a heavy duty cradle/skid which is adapted to forklift transportation.

This 625 gallon tank manufactured by C.E. Howard met the DOT 57 standards when purchased.

The 750 gallon stainless steel tank has an over all length of about 10' and stands 6' high. The outside diameter of the tank is about 4'6". Like the 625 stainless steel tank, it also has a three valve arrangement: a 3" cam lock inlet valve at the top of the tank, a 24" manway, and a 3" drain line. The inlet valve is not guarded. The large, vented manway on top of the tank is sealed by a heavy lid weighing about 35 lbs. The flat "neoprene ring" manway gasket is independent of the lid. The lid is secured, when closed, by 16 stainless steel bolts which are permanently mounted on pivots on the tank. These bolts are secured to the tank lid with wing nuts. The bottom drain line extends perhaps 2'6" out from one end of the tank. This 3" diameter drain line is protected by a heavy duty skid which shrouds the entire line. The skid for this portable container has forklift brackets mounted on it like the other portable containers described so far. This tank was constructed to specific LLNL specifications by Kennedy Tank Co.

The 500 gallon polyethylene globe. This round poly globe rests within a metal framework on a short double axle trailer. This sturdy metal trailer has California license plates and can be transported via public road off the LLNL site. Their are two openings in this portable tank; one at the top, and one at the bottom. The top opening has a diameter of about 12", and seals to the tank via large threads and a gasket. The top opening is plumbed to for liquid transfer. The bottom of the tank has a 2" line leaving the tank. Both lines leading from the tank ports pass through a Honda pump mounted on the trailer. This 3.5 horse power pump is used to pump wastewater through the top opening, or evacuate the wastewater through the bottom port. All piping is 1" or 2" (diameter) hard pipe, generally copper, or stainless steel fitted with quick connect cam locks. The pump is isolated from the plumbing with stainless steel flex lines to prevent pump hammering, and breaking of the lines. The metal trailer can be pulled using a standard trailer hitch and ball set up commonly found on pickup trucks.

The last container evaluated is the double wall polyvinyl chloride (pvc) tank manufactured by Peabody. This cylindrical tank is vertically mounted on a forklift skid. This pvc tank differs from the other poly tanks, which are formed in a mold, and are essentially one piece with the exception of the valves and fittings. This tank is manufactured in different parts: inner cylinder, outer cylinder, top plate and bottom plate. These different parts are then glued to form the tank, with the exception of the top plate which is bolted to the tank. A gasket is installed between the top of the tank and the cylinder to prevent leakage. This tank has four openings in the top, and two near the bottom. The top of the tank has a 10" opening for cleaning and general access; a 2" threaded access to allow fluid transfer; 2" vent port and a small 3/4” threaded port in which a liquid level indicator has been installed. The bottom of the tank has two ports: a

2" threaded drain valve installed with a ball valve, and a 1/2" drain opening to the secondary containment. This 1/2" drain has a threaded plug, which can be accessed for liquid removal. This container was constructed to meet specific LLNL design standards.

Container Evaluation

This portion of the research will evaluate the different containers studied to determine the best container to store wastewater from floor finish removal on the LLNL site. More precisely, this will evaluate how the waste is stored by HWM prior to the transfer of the waste into the main hazardous waste storage facility, the 612 complex.

55 Gallon Drum

The first container that this research will evaluate is the 55 gallon steel drum, the Buckeye Mainstream Sealer-Finish (floor wax) product drum. There are several advantages and disadvantages of this container as can be seen in the Portable Container Interpretive Chart, Table 4.18.

The primary advantages can be summarized as follows: container cost is zero; drums can be stored in the workplace; drums are easy to secondarily contain; and a representative sample can be obtained relatively easily with a COLIWASA.

Although 55 gallon 17E drums have these advantages they have the following disadvantages: their volume is small when managing a 6000 gallon wastestream each year; paperwork is heavy because waste tracking at the LLNL facility is container dependent; drums are more difficult to move than portable tanks; sludge removal is impractical, these drums are not recycled and become a potential hazardous waste themselves when emptied.

The evaluation of the 55 gallon drum in comparison with the other portable containers, despite it's strengths is the poorest container for the management of this wastestream. Although the 55 gallon drum is extremely convenient, and can be stored at

Table 4.18. Portable Container Interpretive Chart p. 1

	55g drum (17 E)	330g tuff tank	660g poly tank	625g steel tank	750g steel tank	500g poly globe	500g double Wall poly
Cost (dollars)	product : 0	in.: 700 Cg.: 500	2248	6800	10000	6000	4651
Value (pts.)	10	7	4	2	0	2	4
H.W. Storage W/O violations	Workplaces & almost all H.W. storage sites.	169 WAA, 495 WAA, 514 Fac., 612 Fac.	169 WAA, 495 WAA, 514 Fac., 612 Fac.	169 WAA, 495 WAA, 514 Fac., 612 Fac.	169 WAA, 495 WAA, 514 Fac., 612 Fac.	Limited storage in: 169 WAA, 495 WAA, 514 Fac. 612 Fac.	All large WAA's
Value (pts.)	10	2	2	2	2	1	6
Non-Haz Storage	Almost anywhere.	Forklift accessible.	Forklift accessible.	Forklift accessible.	Forklift accessible.	Pick up truck accessible.	Forklift accessible.
Value (pts.)	10	7	7	7	7	3	7
Storage volume	very poor	average	good	good	very good	good -	good -
value (pts)	0	4	8	8	10	6	6
valve arrangement	poor	good -	good -	excellent	below average	good -	average
Value (pts.)	2	6	6	10	4	6	5
durability-maintenance	very poor	good -	good -	excellent	excellent	below average	below average
value (pts)	0	6	6	10	9	4	5

Table 4.18. Portable Container Interpretive Chart p. 2

	55g drum (17 E)	330g tuff tank	660g poly tank	625g steel tank	750g steel tank	500g poly globe	500g double Wall poly
ease of obtaining a representative sample	very good COLIWASA	below average COLIWASA	average COLIWASA	average COLIWASA	poor COLIWASA recirculate	below average COLIWASA	poor COLIWASA recirculate
value (pts.)	8	4	5	5	2	4	2
lifespan-recycling	poor	average	average	excellent	excellent	average	below average
value (pts.)	0	5	5	10	10	5	3
ease of sludge removal	poor	good	average	average	average	good	below average
value (pts.)	0	8	5	5	5	8	3
ease of waste transfer	poor	below average	below average	good	average	excellent	below average
value (pts.)	0	4	4	7	5	10	4
ease of transport	below average	good	average	average	below average	poor	average -
value (pts.)	3	7	5	5	3	1	4
Total Points	43	60	57	71	58	50	49

the work place, once it is full it must be moved to a waste accumulation area within three days (assuming it is a hazardous waste). The fact that these drums become potentially hazardous waste themselves once empty, (regardless if the container has been completely cleaned and rinsed) is perhaps the biggest disadvantage. In contrast to drums, portable tanks, after they have had their waste removed are rinsed and cleaned, can be reused.

Full 55 gallon drums are also awkward to handle in the field when moving them from the work site to a WAA. Unlike a portable tank which requires only the appropriate sized forklift to transport, a drum requires either: a drum dolly, or a combination of: a forklift, a drum grabbing device, pallet, security strap and perhaps a drum dolly if the drum is to be moved into a small WAA. These full drums are also rolled when moving to a final resting place on a pallet. Whenever a 400 pound drum of waste is moved with a dolly or by hand, considerable strength, coordination and work experience by the waste handler is required to avoid damage to the container or personal injury.

330 Gallon Tuff Tank

The 330 gallon tuff tank is an excellent portable tank, and one that this research has found to be well suited to the management of wastewater from floor finish removal. The use of the tuff tank would be based not on the quality and ease of use of the container itself, but on the classification of the waste. Where secondary containment of the waste is a requirement, the use of all portable containers is limited to the 169 WAA, and 495 WAA, both operated by the Lasers Program at LLNL. If this wastewater is determined to be non-hazardous then a tuff tank can be stored at any hard surface where it is accessible to a forklift. More to the point, the tuff tank can be stored easily in the long and narrow 511 WAA, operated by Plant Engineering who generates this wastewater.

The 330 gallon tuff tank has the additional advantage of being a DOT E container with well protected valves, and a heavy duty metal cage. The poly container having a curved base, is a problem when obtaining a representative sample, but a benefit when it comes to removing the considerable sludge that will accumulate in the container bottoms with this wastestream. The small rectangular footprint of the 330 gallon Tuff Tank (4'X4') is also a benefit because it can be stored in a smaller area and transported easier.

The two primary disadvantages of the tuff tank are: its lack of camlock fitting at the top of the tank, and it's smaller volume. A fitting with a quick connect cam fitting at the top of the tank is a considerable benefit to the waste handler because they are excellent line connectors. With out camlocks the waste handler must personally hold the line as it passes into the tank during waste transfer. Camlock fittings, by providing a good connection to the portable tank also prevents entrance of rain and reduces the opportunity for splashing of the waste to the waste handler or the environment. The somewhat smaller volume of the tuff tank is a disadvantage when managing an annual volume of 6000 gallons. This size tank would require the tuff tank to be filled, sampled, and processed through Hazardous Waste Management's Requisition Office 20 times to handle the yearly volume.

<u>660 Gallon Poly Tank</u>

With the exception of size and protective cage the 660 poly tank has essentially the same benefits and concerns as the 330 gallon tuff tank. The primary problem is the classification of the wastewater. If it's hazardous, storage locations for the waste outside of the HWM facilities become a sever limitation. The size of this tank makes it more difficult to transport and store. A larger capacity forklift is required for transportation, requiring the HWM waste technician to obtain a forklift from HWM as opposed to the more conveniently located, smaller forklift operated by Plant Engineering which can transport the 330 gallon Tuff Tank.

If this waste is considered to be non-hazardous this 660 gallon container has several advantages. This poly tank, though twice as large as the 330 tuff tank, still can be managed within the 511 WAA. The larger volume would also allow the waste to be sampled and processed with half the effort (required for a 330 gallon container); a substantial cost and energy savings. A disadvantage of this tank when compared to all of the other single walled portable containers is it's susceptibility to damage during transportation. Although the valves are recessed, this tank lacks a protective cage, leaving it vulnerable in the event of a forklift accident. A release of this wastewater, even though it may not be hazardous poses an environmental threat. A cleanup and environmental write up of a release of 600 gallons of this wastewater would be very costly and time consuming.

Unfortunately, like the 330 gallon tuff tank, this tank lacks a quick connect cam fitting at the top of the tank which could provide a safer, more convenient filling of the tank.

As the comparative evaluation shows (Table 4.18) this tank ranks below the tuff tank, and the other stainless steel tanks, primarily because of it's lack of durability and lack of top mounted cam fitting. Although this tank is lighter than the steel tank, the gain in ease of transportation does not balance the vulnerability to forklift damage. Taking all factors into consideration, this tank ranks in the middle of the pack as far as it's ability to safely and conveniently store wastewater from floor finish removal.

<u>625 Gallon Steel Tank</u>

This durable tank, using the comparative evaluation chart, scored the best of all portable containers used at the LLNL site; scoring excellent (tens) in the categories of valve arrangement, durability and life span & recyclability. These tanks are the work horses of HWM because of their versatility and ease of use. This tank has an 18" manway with camlock fittings, allowing for easy access and easy cleaning of the tank. The large manway on the top of the container is very important when you have a waste with high solids content such as wastewater from floor finish removal. The gasket on this lid is fixed in place, giving it an advantage over the 750 gallon tank which has a loose gasket, which occasionally falls into the waste liquid in the tank. The valve arrangement of this tank is ideally matched with the wastewater practices on site, having an inlet valve at the top of the tank and a drain at the bottom, both equipped with quick connect 2" cam fittings.

The three primary drawbacks of the stainless steel 625 are its relatively high purchase price, larger size (for a small WAA), and lack of internal sloping which would make the tank even easier to drain. Even when these factors are included, this tank is the best portable container to use wherever space permits.

<u>750 Gallon Steel Tank</u>

The 750 gallon tank, although it's score was equal to that of the 330 gallon tuff tank, it's size, weight, and valve set up make it less user friendly than the other containers. Although this tank is extremely durable and sturdy, the fact that the manway cover is heavy and is closed with numerous bolts, makes it awkward to open the tank during a waste transfer operation. The increased weight and size of the tank, for the storage of a larger volume of waste, exceeds the lifting capacity for most forklifts used by HWM or Plant Engineering. The overall length of this portable container also makes it awkward to store in a Waste Accumulation Area. Therefore despite this tanks durability and larger storage size, it generally is not a very easy tank to use when transporting, storing or transferring wastewater.

The 750 gallon stainless steel tank would be appropriate where larger volume waste streams are managed, and the requisite forklift, and storage space is available. This tank does provide for an additional 150 gallons or so of storage volume, and if a program has the area to store this larger tank, the volume considerations may outweigh the ease of container management and storage considerations.

500 Gallon Poly Globe

The 500 gallon poly globe is built for the specific purpose of purging of monitoring wells. For hazardous wastewater management, where the waste will generally pass into a WAA, this container is awkward because of it's size, and the requirement that it be moved via a truck-trailer hitch. Although HWM can manage containers on a trailer; it is more difficult to move these portable tank-trailers when parking them in WAA with limited space.

The 612 complex, which has specific areas permitted for portable container storage, is not adapted for handling portable tanks on trailers. The portable tank storage area for the 612 complex is perhaps 100' long and 25' wide. This sloped and burmed storage are can store the other portable tanks evaluated in this research more effectively here because of their smaller foot print and their forklift accessibility (from either side of the container).

If a wastewater is classified as a non-hazardous waste, the use of this poly globe would be enhanced because the trailer could parked in any location. However, this does not decrease the inconvenience in it's management once this container is transferred to the 612 facility.

In conclusion, despite the poly globe's ability to transfer waste easily, the use of this container to store hazardous waste is limited because of the lack of storage space in a WAA, storage limitations in the 612 complex, and the awkward handling necessitated by a trailer hitch set up.

500 Gallon Double Wall Tank

The 500 gallon double wall tank. This container is designed with the specific purpose of secondarily containing hazardous waste liquids in the WAA's where secondary containment is required for all hazardous waste liquids. This tank, although it's volume is adequate and is forkliftable, has a couple of problems which caused it to score poorly when compared with the other portable containers.

This tank has a 10" manway which is small and inconvenient, additionally the tank's internal floor is not sloped to the drain. The 10" manway is secured by 10 bolts requiring a socket set for easy removal of the nuts. Once the 10" lid is removed, the opening to the tank is too small to effectively clean sludge accumulation from the flat tank bottom.

By visual inspection, this tank does not appear to have a complete integral secondary containment. The only portion of this tank that is secondarily contained is the circular wall. Both the top and bottom of the tank appear to be of a single walled construction. The drain valve assembly is also not secondarily contained. This secondarily contained wall of the tank does provide a safety factor when damage to the side of the tank is of concern, but the complete secondary containment for hazardous waste liquids when stored in Waste Accumulation areas is not satisfied.

Container Evaluation Summary

When evaluating all portable tanks, including the 55 gallon drum, the best portable containers are the 625 gallon stainless steel tank, 660 gallon poly tank and the 330 gallon tuff tank. These three tanks are the most frequently used portable containers at LLNL. These containers all have the advantage of being forkliftable, with direct drainage from a 2" cam fitting at the bottom of the tank, and a manway at the top of the tank with a manway lid that is easy to open and close. In choosing the best container of these three depends primarily on waste volume, functionality, and WAA storage space.

CHAPTER 5

CONCLUSION

Overview

This research has examined the process of floor finish removal at LLNL, along with historical analytical data, toxicological references, and the process of generating wastewater from floor finishing, in order to determine if this wastestream is a hazardous waste. In addition to the appropriate characterization of the waste, this research evaluated the different storage containers utilized for the management of wastewater from floor finish removal in order to determine which container would be most appropriate for it's storage while on the Lawrence Livermore Lab site.

This research problem of classifying, and storing wastewater from floor finishing was divided into three subproblems designed to answer the following the questions:

1. Given that some of the historical analysis of wastewater from floor finish removal showed hazardous concentrations of zinc, lead and pH; if this data is analyzed statistically via the approved procedure in SW-846 is the wastestream as a whole considered hazardous?
2. Using CCR 22 there are other methods which allow for the evaluation of waste toxicity; using these methods, is wastewater from floor finish removal a toxic (hazardous) waste?
3. Once a decision is made on the classification of wastewater from floor finish removal, what is the best portable container for it's on site storage?

The three corresponding hypothesis to these subproblems are:

1. The application of the SW-846 statistical methods for waste classification will show that this waste is not hazardous due to the zinc, lead or pH of this wastestream.

2. The evaluation of the MSDS sheets, generator knowledge, toxicological references, and historical analytical data will show that this waste is not a toxic waste as regulated by the state of California.

3. The 625 gallon stainless steel portable tank is the most appropriate storage container for the on site storage of wastewater from floor finish removal.

Subproblem One: Hazardous Waste Determination via Statistical Analysis

The application of the "STRATEGY FOR DETERMINING IF CHEMICAL CONTAMINANTS OF SOLID WASTES ARE PRESENT AT HAZARDOUS LEVELS - General Procedures" was challenging, frustrating and rewarding. This method showed that this wastestream was non-hazardous for the suspected hazardous constituents zinc, lead and pH. This statistical method was very awkward to apply, and has poor statistical credibility in regards to the data transformations.

Discussions with John Low, Hazardous Materials Scientist of the CAL-EPA and Ollie Fordham, (chemist with the EPA who is responsible for the rewrite of Chapter 9 of SW-846), made it very clear that the comparison of the mean concentration of the contaminant with the calculated variance was not valid for determining the appropriate data transformation and that these data transformations (arcsine and square root) were not appropriate for determining the 90% confidence level ultimately compared to the regulatory threshold for waste classification! This information was even more frustrating when Fordham stated that the rewrite of Chapter 9 is "years off" (Fordham 1995).

The current EPA guidance in reference to the data transformations is to assume that the analytical data fits a normal distribution unless it “can be proven” that it does not, and perform the statistical evaluation upon this untransformed data.

The use of the various combinations of TTLC database, STLC hybrid data base, and the STLC ratio illustrate a novel, yet unproved method of characterizing metal contaminants in a waste. The use of the TTLC and STLC data together proved to be helpful in determining the mean concentration of the soluble fraction where TTLC values frequently exceeded the STLC thresholds, and a relatively few number of STLC analysis were performed. Although this approach of producing a STLC ratio is new, it does have statistical merit, and at a minimum provides insight for waste generators and regulators regarding the soluble fraction of metal contaminants in a particular waste.

The importance of appropriate and accurate waste sampling was also an important aspect of wastewater classification. In characterizing wastewater from floor finish removal it was not apparent that the waste was not hazardous until the solids content was considered. Without accurate sampling and analysis of the solids content, the wastewater from floor finishing could not have been characterized accurately.

For this wastewater, it was initially presumed to be a liquid waste where the TTLC metal concentrations could be assumed to be compared to the STLC regulatory threshold because it was not understood that this waste had a significant solids content. With the inclusion of the STLC analysis, the data showed that a significant fraction of the metals were not soluble, and in most cases the soluble metal concentrations were below the regulatory threshold for zinc and lead.

In addition to the metals the pH of this waste was evaluated statistically, even though the SW-846 procedure does not address contaminants other than metals. The statistical methodology in evaluating wastewater from floor finishing appeared to be valid. Current EPA guidance is unclear on the statistical evaluation of pH. Fordham of the EPA suggested that "pH should be evaluated on a container by container basis ".

In conclusion this statistical evaluation of wastewater (via SW-846) from floor finish allowed for the application of a rarely used tool (statistics) for the determination of the waste as hazardous or not with mixed results. The bottom line is, that wastewater from floor finish removal is statistically not hazardous. Given this statistical knowledge someone must then make the management decision on how to label and store this waste. This decision will probably be made based on liability, and a balancing of other issues such as waste storage capacity, perception of the waste as hazardous or not (not it's actual regulatory toxicity), personnel training, regulatory involvement in the issue, and money. The statistical evaluation of the waste generates hard numbers, the specific guidance on how to generate these numbers however is a bit softer, and the management decision on how to interpret these numbers becomes even more complicated by other concerns.

Subproblem Two: Determination of Wastewater Toxicity

As a guideline this research followed the regulatory guidance on toxicity, page 50 of the *Waste Classification Regulation Guidance Manual.* (Appendix H). This toxicological evaluation relied primarily on four key sources of data: the material safety data sheets for floor maintenance products (Mainstream Floor Finish, First Down Floor Sealer, Revelation Floor Finish Remover, Straight Up Floor Finish Cleaner), generator knowledge of the finish removal process, historical analytical data, and toxicity reference data from *Sax's Dangerous Properties of Industrial Materials*..

The interpretive charts for cumulative acute dermal toxicity, cumulative acute ingestion toxicity, and inhalation toxicity all indicated the wastewater to be non-hazardous. This non-hazardous waste determination is important but it relies very heavily on the quality of the material safety data sheets, when in fact there is a great deal of inconsistency in the quality of these product information sheets.

In completion of the calculation where the weight percents of the hazardous ingredients are divided by their respective LD50's, then summed before dividing into 100 this research applied another infrequently used tool for the purpose of waste classification. The most important fact illustrated here is that materials which were originally perceived to be the main "toxic" ingredients (lead, zinc, pH) of the waste stream are basically non factors when evaluating the dermal toxicity, inhalation toxicity and ingestion toxicity. In evaluating the acute toxicity of this waste the product ingredients played a much greater role than the metals. The metals represented at most one percent of the toxic load for any of the cumulative toxicity calculations: dermal, ingestion or inhalation! See tables 4.14 and 4.15. In conclusion this research shows the importance of evaluating all potential regulated characteristics of toxicity before a hazardous - non-hazardous determination is made.

The choice of toxicity data utilized for each product ingredient is also critical in determining the toxicity of the waste. This problem was illustrated in the examination of the inhalation toxicity where the toxicity data for the monomer methyl acrylate was used in estimating the toxicity for the acrylate copolymer. The monomer is perhaps 100 orders of magnitude more toxic than the copolymer, therefore it is important to verify that substituted toxicity data is relevant and comparable to the actual chemical(s) in the waste.

Evaluating the cumulative inhalation hazard via the methodology used for dermal and ingestion toxicity, although not accepted by the California regulations, provides the generator greater insight into the characteristics and toxicity of the waste. The inhalation toxicity can also be estimated by determining the vapor pressure of a hazardous constituent in a waste, and assuming the waste is 100% of this inhalation toxin. This vapor pressure converted into parts per million then can be compared to the LD_{50} of that ingredient. Where the vapor pressure of the ingredient exceeds the LD_{50} for that specific chemical and the LD50 is less than 10,000 ppm the waste can be assumed to be toxic via inhalation.

The acute fish toxicity test, since it was completed in conjunction with metals analysis was used comparatively to inductively determine if the wastestream as a whole was acutely toxic to fish. Since none of the fish died at 1000 mg/kg this data allowed for some margin of error in the non-hazardous classification of this wastestream.

The chronic toxicity of wastewater from floor finish removal was not an issue because generator knowledge, and historical analytical data indicates that there aren't any constituents in the floor care products with chronic toxicity thresholds in Title 22.

The use of the various methods in Title 22 allowing quantitative evaluation of toxicity points out that there are many factors which can cause a waste to be toxic, and on occasion a waste maybe toxic due to factors that are not initially recognized. In applying these toxicity evaluation strategies it illustrates that these rarely used tools in the classification of a waste are helpful in obtaining a more comprehensive evaluation of a waste's toxicity (See Table 5.1).

Subproblem Three: Determination of Portable Wastewater container

Initially this research suggested that the determination of this waste as hazardous or not would determine what container this wastewater would be stored in. However, after a closer examination, the waste composition, and the waste classification are minor factors. The primary consideration for the choice of containers being their ease in management by the HWM staff. Although the 55 gallon drums are easy to accumulate waste in they are difficult to move, have more paperwork per unit volume of waste, sludge removal is nearly impossible and for a wastestream of an annual volume of 6000 gallons they are not practical. Consequently the choice of containers for wastewater from floor finish removal suggests a portable tank. In the event that the wastewater from floor finishing is a hazardous waste, a portable tank could be used to containerize the waste for it's storage in the 511 WAA. The inclusion of the 511 WAA into the decision making process for container choice effectively eliminates the use of the 750 gallon Kennedy tank, and the 500 gallon poly globe based on the size of the WAA alone.

Based on the surveys of the Hazardous Waste Technicians, and the comparative

Table 5.1. Toxicity Summary

Waste Characteristic	Applicable CCR 22 Section	Method of Determination	Sources of Information	Hazardous Waste Decision
Zinc	66.261.24(a)(2)	Statistical Evaluation of Analytical Data.	Historical Analytical Data. SW-846, Ch. 9	no
Lead	66.261.24(a)(2)	Statistical Evaluation of Analytical Data.	Historical Analytical Data. SW-846, Ch. 9	no
Cumulative dermal Toxicity	66.261.24(c)	Calculation as per 66.261.24(c)	MSDS's, generator knowledge, toxicity references	no
Cumulative Ingestion (oral) Toxicity	66.261.24(c)	Calculation as per 66.261.24(c)	MSDS's, generator knowledge, toxicity references	no
Inhalation Toxicity	66.261.24(a)(5) & 66.261.24(b)	Headspace gases exceed specific toxicity thresholds and are present at levels equal to or greater than 10000 ppm	Waste analysis via EPA method 5020	Not applicable. Waste analysis was not performed.
Chronic Toxicity	66.261.24(a)(7)	Evaluation of Listed Wastes	Waste Analysis MSDS, 66.261.24(a)(7)	no
Acute Aquatic Toxicity	66.261.24(a)(6)	Waste Analysis, Comparison with RT	Waste Analysis	no
pH	66.261.20.(2)(B) 66261.22.(a)(1)	Generator Knowledge, Waste Analysis & Comparison with RT	MSDS Waste Analysis	no

chart, the best container for the storage of wastewater from floor finish removal is the 625 gallon stainless steel tank (see appendices J, K and Table 4.18.). This tank has the advantage of being easy to forklift, an easy opening manway with a large opening, cam lock fittings allowing easy waste transfer, and of course the durability of the steel construction. The only drawbacks of the 625 stainless steel are that it is not secondarily contained, and the internal floor of the tank is not sloped towards the drain line.

Summary

Within SW-846, and Title 22 there are statistical methods, and toxicological formulas for hazardous waste determination. These methods, although rarely used and difficult to apply correctly, can provide the environmental manager with additional information allowing more accurate waste classification. These tools are particularly helpful when evaluating a large volume wastestream that is relatively consistent and it's toxicity is close to the regulatory threshold. These statistical manipulations and toxicity data bases generated in evaluating waste could be easily adapted using current computer software such as Microsoft Excel. With these statistical and toxicological methods adapted to the Excel software, and appropriate training, waste classification could become more consistent and scientifically grounded. Even if the statistical concepts, and toxicological concepts are not fully understood in their application to waste classification, the results of their application have a scientific basis, and merit consideration when determining a waste management strategy.

Using current regulatory guidance this research has shown wastewater from floor finish removal to be a non-hazardous waste. Although this waste was shown to be non-hazardous, the waste manager must make the ultimate decision on how the waste is characterized and managed. Often times the management decision is not based on if the waste is truly hazardous, but on money, public perception, liability, and operational constraints. It is for these reasons that although the wastestream wastewater from floor finishing maybe truly non-hazardous, from a political and management stance it may be appropriate to manage this wastewater as a hazardous waste.

The choice of an appropriate container for wastewater from floor finish removal was based on a survey of the portable container users, and a subjective evaluation chart. This information proved to be effective in choosing the best "all around" container. Choosing an appropriate container however, is wastestream specific, where the choice of container is based on the volume of the waste, where the waste is stored, and the composition of the waste.

For the management of wastewater from floor finish removal, site specific factors such as the size of the WAA and the volume of the wastewater generated limited the reasonable containers to the: 330 gallon tuff tank, 660 poly tank, 500 gallon duo containment tank and the 625 gallon steel tank. All four of these containers would work quite well for the management of this wastestream. Given a choice, the 625 gallon steel tank because of it's size, durability and ease of use was found to be the best overall container for wastewater from floor finish removal.

Recommendations

All Lawrence Livermore Laboratory Hazardous Waste Management, and Environmental Protection Department (EPD) employees responsible for waste classification should understand how to implement the SW-846 statistical methodology with the assumption that all wastestreams exhibit a normal distribution of contaminants with in that waste. The application of this statistical evaluation should be computed using a spreadsheet such as Excel, and be able to evaluate one wastestream with 10-20 pieces of analytical data in less than two hours.

All (LLNL) HWM and EPD employees responsible for waste classification should understand how to implement the Title 22 toxicology methodologies using MSDS's from the product waste, historical analytical data, generator knowledge, and the use of toxicology references.

Portable containers, specifically tanks should be used where ever waste volume permits. The use of 55 gallon drums should be minimized when dealing with wastestreams having a volume of 1000 gallons or more per year.

This research recommends that LLNL work together with the CAL-EPA and the Federal EPA in the establishment of a statistical methodology which can be applied to the classification of all types of hazardous waste regulatory thresholds, not just metal thresholds. These statistical methodologies should incorporate current national and international standards where appropriate.

California Hazardous Waste Regulations: Definitions

Section: 66260.10
Reference: California Regulations | Title 22 | Division 4.5 | Chapter 10 Article 2. Definitions.

When used in this division, the following terms have the meanings given below:

"Aboveground tank" means a device meeting the definition of "tank" in Section 66260.10 and that is situated in such a way that the entire surface area of the tank is completely above the plane of the adjacent surrounding surface and the entire surface area of the tank (including the tank bottom) is able to be visually inspected.

"Accidental occurrence" means an accident, including continuous or repeated exposure to conditions, which results in bodily injury, property damage or environmental degradation neither expected nor intended from the standpoint of the insured.

"Accumulated speculatively" means that a material is accumulated before being recycled. A material is not accumulated speculatively, however, if the person accumulating it can show that the material is potentially recyclable and has a feasible means of being recycled; and that, during the calendar year (commencing on January 1), the amount of material that is recycled, or transferred to a different site for recycling, equals at least 75 percent by weight or volume of the amount of that material accumulated at the beginning of the period. In calculating the percentage of turnover, the 75 percent requirement is to be applied to each material of the same type (e.g., slags from a single smelting process) that is recycled in the same way (i.e., from which the same material is recovered or that is used in the same way). Materials accumulating in units that would be exempt from regulation under Section 66261.4(c) are not to be included in making the calculation. (Materials that are already defined as wastes also are not to be included in making the calculation.) Materials are no longer in this category once they are removed from accumulation for recycling, however.

"Active life" or "Operating life" of a facility means the period from the initial receipt of hazardous waste at the facility until the Department receives certification of final closure.

"Active portion" means that portion of a facility where transfer, treatment, storage or disposal operations are being or have been conducted after November 19, 1980 and which is not a closed portion.

"Activity" means any activity that is subject to regulation under this division.

"Acute aquatic 96-hour LC(50)" means the concentration of a substance or mixture of substances in water, in milligrams per liter, which produces death within 96 hours in half of a group of at least 10 test fish.

"Acute dermal LD(50)" means the dose of a substance or mixture of substances, in milligrams per kilogram of test animal body weight, which, when applied continuously to the bare skin for 24 hours, produces death within 14 days in half of a group of 10 or more rabbits.

"Acute inhalation LC(50)" means the lowest concentration of a substance or mixture of substances in air, other than acute inhalation LD(50) in parts per million by volume if the substance or mixture of substances is a gas or vapor, reported to have caused death in humans or animals.

"Acute inhalation LC(50)" means the concentration of a substance or mixture of substances in air, in parts per million by volume if the substance or mixture of substances is a gas or vapor, which when inhaled continuously for 8 hours by a group of 10 or more laboratory white rats, each weighing between 200 and 300 grams, produces death in half the group within 14 days.

"Acute LD(50)" means the lowest dose, other than an acute LD(50) of a substance or mixture of substances, in milligrams per kilogram body weight introduced orally or dermally over any given period of time in one or more divided portions and reported to have caused death in humans or animals.

"Acute oral LD(50)" means the dose of a substance or mixture of substances, in milligrams per kilogram of test animal body weight, which, when administered orally as a single dose, produces death within 14 days in half of a group of 10 or more laboratory white rats which have fasted for 24 hours immediately prior to administration of the dose, and which weigh between 200 and 300 grams each.

"Acute toxicity" Means the ability of a substance or mixture of substances to cause injury, illness or damage to humans, animals or other living organisms by a single exposure of a duration measured in seconds, minutes, hours or days or, in the case of oral ingestion, by a single dose.

"Acute hazardous waste" see "Acutely hazardous waste".

"Acutely hazardous waste" or "Acute hazardous waste', means any hazardous waste classified as an acutely hazardous waste in Article 4 of chapter 11 of this division.

"Administrator" see "USEPA Administrator".

"Affected medium" means any medium (e.g. ground water, surface water or the unsaturated zone) that has been affected by a release from a regulated unit.

"Air stripping operation" is a desorption operation employed to transfer one or more volatile components from a liquid mixture into a gas (air) either with or without the application of heat to the liquid. Packed towers, spray towers, and bubble-cap, sieve, or valve-type plate towers are among the process configurations used for contacting the air and a liquid.

"Ancillary equipment" means any device including, but not limited to, such devices as piping, fittings, flanges, valves and pumps, that is used to distribute, meter or control the flow of hazardous waste from its point of generation to a storage or treatment tank(s), between hazardous waste storage and treatment tanks to a point of disposal onsite, or to a point of shipment for disposal offsite.

"Applicant" means a person who applies to the Department or to the USEPA for a permit, registration, certification or permission to take specified action, pursuant to the provisions of this division.

"Application" means

(a) the USEPA standard national forms for applying for a permit (Form EPA 8700-23, Revised 1/90) and the information required by the Department under Sections 66270.14 through 66270.29 (contents of Part B of the application); or

(b) the forms approved by the Department for applying for registration as a hazardous waste hauler. These forms are:

Form EH 187, revised 8/89: Hazardous Waste Hauler Application

Form DHS 8025, revised 6/90: Application for vehicle/container inspection

Form DHS 8038, revised 5/85: Certificate of Insurance Form DHS 8430, revised 3/89: Disclosure Statement

"Aquifer" means a geologic formation, group of formations or part of a formation capable of yielding a significant amount of ground water to wells or springs.

"Assets" means all existing and all probable future economic benefits obtained or controlled by a particular entity.

"Authorized representative" means the person responsible for the overall operation of a facility or an operational unit (i.e., part of a facility), e.g., the plant manager, superintendent or person of equivalent responsibility.

"Background monitoring point" means a well, device or location specified in the facility permit at which monitoring for background water, soil, air or soil-vapor quality is conducted.

"Bioaccumulative toxic substance" means a toxic substance that concentrates in living organisms through direct assimilation or food chain accumulation.

"Bodily Injury" means

(a) any injury that causes physical pain, illness or any impairment of physical condition; or

(b) for the purposes of chapter 13 of this division, "bodily injury" means injury to the body, sickness or disease to any person, including death resulting from any of these.

"Boiler" means an enclosed device using controlled flame combustion and having the following characteristics:

(a)(1) the unit must have physical provisions for recovering and exporting thermal energy in the form of steam, heated fluids or heated gases; and

(2) the unit's combustion chamber and primary energy

recovery section(s) must be of integral design. To be of integral design, the combustion chamber and the primary energy recovery section(s) (such as waterfalls and superheaters) must be physically formed into one manufactured or assembled unit. A unit in which the combustion chamber and the primary energy recovery section(s) are joined only by ducts or connections carrying flue gas is not integrally designed; however, secondary energy recovery equipment (such as economizers or air preheaters) need not be physically formed into the same unit as the combustion chamber and the primary energy recovery section. The following units are not precluded from being boilers solely because they are not of integral design: process heaters (units that transfer energy directly to a process stream), and fluidized bed combustion units; and

(3) while in operation, the unit must maintain a thermal energy recovery efficiency of at least 60 percent, calculated in terms of the recovered energy compared with the thermal value of the fuel; and

(4) the unit must export and utilize at least 75 percent of the recovered energy, calculated on an annual basis. In this calculation, no credit shall be given for recovered heat used internally in the same unit. (Examples of internal use are the preheating of fuel or combustion air, and the driving of induced or forced draft fans or feedwater pumps); or

(b) the unit is one which the USEPA Regional Administrator has determined, on a case-by-case basis, to be a boiler, after considering the standards in 40 CFR Section 260.32.

"Border zone property" means any property designated as border zone property pursuant to Health and Safety Code Section 25229 which is within 2,000 feet of a significant disposal of hazardous waste, and the wastes so located are a significant existing or potential hazard to present or future public health or safety on the land in question.

"Bottoms receiver" means a container or tank used to receive and collect the heavier bottoms fractions of the distillation feed stream that remain in the liquid phase.

"Buffer zone" means an area of land which surrounds a hazardous waste facility and on which certain land uses and activities are restricted to protect the public health and safety and the environment from existing or potential hazards caused by the migration of hazardous waste.

"Bulking" means the process of consolidating various quantities of the same type of waste by placing them into a single, larger container.

"Business" means the conduct of an activity and is not limited to a commercial or proprietary activity.

"Business concern" means any sole proprietorship, corporation, association, firm, partnership, trust or other form of commercial organization.

"By-product" is a material that is not one of the primary products of a production process and is not solely or separately produced by the production process. Examples are process residues such as slags or distillation column bottoms. The term does not include a co-product that is produced for the general public's use and is ordinarily used in the form it is produced by the process.

"Cargo tank" means any tank permanently attached to, or a structural part of, a vehicle; or any bulk liquid or compressed gas packaging that is not permanently attached to a vehicle and by reason of its size, construction or method of attachment is filled or emptied without removal from the vehicle. The term does not include tanks that furnish fuel for propulsion of motor vehicle, or auxiliary equipment on which they are installed or any packaging fabricated to cylinder specifications.

"Certification" means a statement of professional opinion based upon knowledge and belief.

"Chemical toilet" means any portable or permanently installed sanitation apparatus or system which utilizes a tank for toilet waste retention and into which a chemical toilet additive is added.

"Chemical toilet additive" means any chemical substance, biological agent, other material or formulation thereof, which is employed for the primary purpose of controlling waste decomposition and odors in a chemical toilet holding tank or any tank in which chemical toilet wastes are held, collected or transported. The term "chemical toilet additive" includes, but is not limited to, a chemical substance, biological agent or other material which is a deodorant, bactericide, bacteriostat, microbiocide, chemical reactant, surfactant or enzymatic agent.

"Chemical toilet waste" means the waste in or from a chemical toilet.

"Chronic toxicity" means the ability of a substance or mixture of substances to cause injury, illness or damage to humans, animals or other living organisms by prolonged or repeated exposure or consumption over a period of days, weeks, months or years.

"Class I Violation" means:

(a) a deviation from the requirements specified in Chapter 6.5 of Division 20 of the Health and Safety Code, or regulations, permit or interim status document conditions, standards, or requirements adopted pursuant to that chapter, that represents a significant threat to human health or safety or the environment because of

(1) the volume of the waste;

(2) the relative hazard of the waste; or

(3) the proximity of the population at risk, or that is significant enough that it could result in a failure to accomplish the following:

(A) Assure that hazardous wastes are destined for and delivered to an authorized hazardous waste facility;

(B) Prevent releases of hazardous waste or constituents to the environment during the active or post closure period of facility operation;

(C) Assure early detection of such releases;

(D) Assure adequate financial resources in the case of releases; or

(E) Assure adequate financial resources to pay for facility closure;

(F) Perform emergency clean-up operation or other corrective action for releases; or

(b) The deviation is a Class II violation which is a chronic violation or committed by a recalcitrant violator.

"Class II Violation" means a deviation from the requirements specified in Chapter 6.5 of Division 20 of the Health and Safety Code, or regulations, permit or interim status document conditions, standards, or requirements adopted pursuant to that chapter, that is not a Class I violation.

"Closed portion" means that portion of a facility which an owner or operator has closed in accordance with the approved facility closure plan and all applicable closure requirements and for which the Department has released the owner and operator from the financial assurance requirements for closure under section 66264.143(j) or section 66265.143(i).

"Close-vent system" means a system that is not open to the atmosphere and that is composed of piping, connections, and, if necessary, flow-inducing devices that transport gas or vapor from a piece or pieces of equipment to a control device.

"Closure" means the act of closing a hazardous waste management facility or hazardous waste management unit to pursuant the requirements of chapters 14 and 15 of this division.

"Closure period" means the period during which a unit at a hazardous waste management facility is being closed according to an approved closure plan.

"Closure plan" means the plan for closure prepared in accordance with section 66264.112 or section 66265.112.

"Commence" means to receive the first delivery of waste.

"Component" means any constituent part of a unit or any group of constituent parts of a unit which are assembled to perform a specific function (e.g., a tank or ancillary equipment of a tank system, a pump seal, pump, kiln liner, kiln thermocouple).

"Concentration limit" means the value for a constituent specified in the water quality protection standard or environmental protection standard including, but not limited to, values for concentration, temperature, pH, conductivity and resistivity.

"Condenser" means a heat-transfer device that reduces a thermodynamic fluid from its vapor phase to its liquid phase.

"Confined aquifer" means an aquifer bounded above and below by impermeable beds or by beds of distinctly lower permeability than that of the aquifer itself; an aquifer containing confined ground water.

"Connector" means flanged, screwed, welded, or other joined fittings used to connect two pipelines or a pipeline and a piece of equipment. For the purposes of reporting and recordkeeping, connector means flanged fittings that are not covered by insulation or other materials that prevent location of the fittings.

"Consignee" means the ultimate treatment, storage or disposal facility in a receiving country to which the hazardous waste will be sent.

"Constituents of concern" means any waste constituents, reaction products and hazardous constituents that are reasonably expected to be in or derived from waste contained in a regulated unit.

"Container" means, except for purposes of the annual inspections and the issuance of the certificates of compliance required by chapters 12 and 13 of this division, any device that is open or closed, and portable in which a material can be stored, handled, treated, transported, recycled or disposed of. For purpose of the annual inspection and the issuance of the certificates of compliance required by chapters 12 and 13 of this division, "container" means any portable tank as defined in section 1160.3(j) of title 13 of the California Code of Regulations or any covered or uncovered receptacle to be used for transporting hazardous waste and having a capacity greater than 110 U.S. gallons (416.4 liters).

"Containment building" means a hazardous waste management unit that is used to store or treat hazardous waste under the provisions of article 20 of chapters 14 or 15 of this division.

"Contingency plan" means a document setting out an organized, planned, and coordinated course of action to be followed in case of a fire, explosion, or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

"Continuous recorder" means a data-recording device recording an instantaneous data value at least once every 15 minutes.

"Control chart" means a graphical method for evaluating whether a process is or is not in a state of statistical control.

"Control device" means an enclosed combustion device, vapor recovery system, or flare. Any device the primary function of which is the recovery or capture of solvents or other organics for use, reuse, or sale (e.g., a primary condenser on a solvent recovery unit) is not a control device.

"Control device shutdown" means the cessation of operation of a control device for any purpose.

"Corrective action management unit" means an area within a facility that is designated by the Department under article

15.5 of chapter 14 of this division, for the purpose of implementing corrective action requirements under articles 6, 15.5, or 17 of chapter 14 of this division or article 18 of chapter 15 of this division, Health and Safety Code sections 25200.10 or 25187, or section 25358.9 where as provided for under the provisions of that section the Department has excluded the removal or remedial action at a site from the hazardous waste facilities permit required by Health and Safety Code section 25201, or federal RCRA section 3008(h) [U.S.C. Title 42, Section 6928(h)]. A corrective action management unit shall only be used for the management of remediation wastes pursuant to implementing such corrective action requirements at the facility.

"Corrosion expert" means a person who, by reason of that person's knowledge of the physical sciences and the principles of engineering and mathematics, acquired by a professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks. Such a person must be certified as being qualified by the National Association of Corrosion Engineers (NACE) or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control on buried or submerged metal piping systems and metal tanks.

"Corrosive" means the ability to cause destruction of living tissue or steel surfaces by chemical action.

"Covered container" means any container which is equipped with a cover or other device that will prevent the escape of a liquid or solid substance when closed.

"Current assets" means cash or other assets or resources commonly identified as those which are reasonably expected to be realized in cash or sold or consumed during the normal operating cycle of the business.

"Current closure cost estimate" means the most recent of the estimates prepared in accordance with section 66264.142 or section 66265.142.

"Current liabilities" means obligations for which liquidation is reasonably expected to require the use of existing resources properly classifiable as current assets or the creation of other current liabilities.

"Current plugging and abandonment cost estimate" means the most recent of estimates prepared in accordance with 40 CFR section 144.62(a), (b) and (c) incorporated by reference in section 66260.11 of this chapter.

"Current postclosure cost estimate" means the most recent of the estimates prepared in accordance with Section 66264.144 or section 66265.144.

"Day" means a calendar day. Periods of time are calculated by excluding the first day and including the last. Except, if the last day is a Saturday, Sunday or other holiday specified in Government Code section 6700 it is also

excluded.
"Debris" means solid material exceeding a 60 mm particle size that is intended for disposal and that is: A manufactured object; or plant or animal matter; or natural geologic material. However, the following materials are not debris: any material for which a specific treatment standard is provided in article 4 of chapter 18 of this division, namely lead acid batteries, cadmium batteries, and radioactive lead solids: process residuals such as smelter slag and residues from the treatment of waste, wastewater, sludges, or air emission residues; and intact containers of hazardous waste that are not ruptured and that retain at least 75% of their original volume. A mixture of debris that has not been treated to the standards provided by section 66268.45 and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection.

"Decontaminate" means to make free of wastes that are hazardous pursuant to the criteria in chapter 11 of this division.

"Department" means the State Department of Health services.

"Designated facility" means a hazardous waste transfer, treatment, storage, or disposal facility which has received a permit (or a facility with interim status) in accordance with the requirements of chapters 20 and 21 of this division, a permit from a State authorized in accordance with Part 271 of Title 40 CFR, or that is regulated under chapter 16 of this division, or has received a permit, a grant of interim status, or a variance to operate without a permit or grant of interim status from the Department, or is otherwise authorized by law to receive specific hazardous wastes, and that has been designated on the manifest by the generator pursuant to Section 66262.20.

"Dike" means an embankment or ridge of either natural or man-made materials used to prevent the movement of liquids, sludges, solids or other materials.

"Director" means the State Department of Health Services Director, or an authorized representative.

"Discharge" or "hazardous waste discharge" means the accidental or intentional spilling, leaking, pumping, pouring, emitting, emptying or dumping of hazardous waste into or on any land or water.

"Disclosure statement," as defined by Health and Safety Code section 25112.5, means either of the following:

(a) a statement submitted to the Department by an applicant, signed by the applicant under penalty of perjury, which includes all of the following information:

(1) the full name, business address, social security number and driver's license number of all of the following:

(A) the applicant;

(B) any officers, directors or partners, if the applicant is a business concern;

(C) all persons or any officers, partners, or any directors if there are no officers, of business concerns holding more than five percent of the equity in, or debt liability of the applicant, except that if the debt liability is held by a lending institution, the applicant shall only supply the name and address of the lending institution;

(2) the following persons listed on the disclosure statement shall submit properly completed fingerprint cards:

(A) the sole proprietor; the partners; other persons listed in subsection (a)(1)(C) of this definition and any officers or directors of the applicant company as required by the Department;

(B) fingerprint cards submitted for any persons required by subsection (a)(2) of this definition shall be submitted once. Fingerprint cards shall be completed and submitted for any additional person only if there is a change in the person serving in a position for which fingerprint cards are required to be submitted pursuant to subsection (a)(2) of this definition. The Department shall use the information required by subsection (a)(2) of this definition to positively identify the applicant.

(3) the full name and business address of any company which generates, transports, treats, stores, recycles, disposes of or handles hazardous waste and hazardous materials in which the applicant holds at least a five percent debt liability or equity interest;

(4) a description of any local, state, or federal licenses, permits, or registrations for the generation, transportation, treatment, storage, recycling, disposal or handling of hazardous waste or hazardous materials applied for, or possessed by the applicant, or by the applicant under any previous name or names, in the three years preceding the filing of the statement, or, if the applicant is a business concern, by the officers, directors or partners of the business concern, including the name and address or the issuing agency;

(5) a listing and explanation of any final administrative orders or license revocations or suspensions issued or initiated by any local, state or federal authority, in the three years immediately preceding the filing of the statement, or any civil or criminal prosecutions filed in the three years immediately preceding, or pending at the time of, the filing of the statement, with any remedial actions or resolutions if applicable, relating to the generation, transportation, treatment, storage, recycling, disposal or handling of hazardous waste or hazardous materials received by the applicant, or by the applicant under any previous name or names, or, if the applicant is a business concern, by any officer, director or partner of the business concern;

(6) a listing of any agencies outside of the state which regulate, or had regulated, the applicant's (or the applicant's under any previous name or names) generation,

transportation, treatment, storage, recycling, disposal or handling of hazardous waste or hazardous materials in the three years preceding the filing of the disclosure statement;

(7) a listing and explanation of any federal or state conviction, judgment, or settlement, in the three years immediately preceding the filing of the statement, with any remedial actions or resolutions if applicable, relating to the generation, transportation, treatment, storage, recycling, disposal or handling of hazardous waste or hazardous materials by the applicant, or by the applicant under any previous name or names, or if the applicant is a business concern, by any officer, director or partner of the business concern;

(8) a listing of all owners, officers, directors, trustees and partners of the applicant who have owned, or been an officer, director, trustee or partner of, any company which generated, transported, treated, stored, recycled, disposed of, or handled hazardous wastes or hazardous materials and which was the subject of any of the actions described in subsections (a)(5) and (a)(7) of this definition for the three years preceding the filing of the statement.

(b) In lieu of the statement specified in subdivision (a) of this definition, a corporation, the stock of which is listed on a national securities exchange and registered under the Securities Exchange Act of 1934, as amended (Title 15 U.S.C. Section 78a et seq.), or a subsidiary of such a corporation, may submit to the Department copies of all periodic reports, including, but not limited to, those reports required by Section 78m of Title 15 of the United States Code and Part 229 (commencing with Section 229.10) of chapter II of Title 17 of the Code of Federal Regulations which the corporation or subsidiary has filed with the Securities and Exchange Commission in the three years immediately preceding the submittal, if the corporation or subsidiary thereof has held a hazardous waste facility permit or operated a hazardous waste facility under interim status pursuant to Health and Safety Code section 25200 or 25200.5 since January 1, 1984.

"Disposal" means:

(a) the discharge, deposit, injection, dumping, spilling, leaking or placing of any waste or hazardous waste into or on any land or water so that such waste or hazardous waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters;

(b) the abandonment of any waste.

"Disposal facility" means a facility or part of a facility at which hazardous waste is intentionally placed into or on any land or water, and at which waste will remain after closure. The term "disposal facility" does not include a corrective action management unit into which remediation wastes are placed.

"Disposal site" means the location where any final deposition of hazardous waste occurs.

"Distillate receiver" means a container or tank used to receive and collect liquid material (condensed) from the overhead condenser of a distillation unit and from which the condensed liquid is pumped to larger storage tanks or other process units.

"Distillation operation" means an operation, either batch or continuous, separating one or more feed stream(s) into two or more exit streams, each exit stream having component concentrations different from those in the feed stream(s). The separation is achieved by the redistribution of the components between the liquid and vapor phase as they approach equilibrium within the distillation unit.

"Double block and bleed system" means two block valves connected in series with a bleed valve or line that can vent the line between the two block valves.

"Draft permit" means a document prepared under section 66271.5 or 40 CFR section 124.6 indicating the Department's tentative decision to issue or deny, modify, revoke and reissue, terminate or reissue a permit. A notice of intent to terminate a permit, and a notice of intent to deny a permit, as discussed in section 66271.4, are types, of draft permits. A denial of a request for modification, revocation and reissuance, or termination, as discussed in section 66271.4 or 40 CFR section 124.5 is not a "draft permit." A proposed permit is not a draft permit.

"Drip pad" means an engineered structure consisting of a curbed, free-draining base, constructed of non-earthen materials and designed to convey preservative kick-back or drippage from treated wood, precipitation, and surface water run-on to an associated collection system at wood preserving plants.

"Elementary neutralization unit" means a device which:

(a) is used for neutralizing wastes which are hazardous wastes only because they exhibit the corrosivity characteristic defined in Section 66261.22, or are listed in article 4 of chapter 11 of this division only for this reason; and,

(b) meets the definition of tank, tank system, container, transport vehicle or vessel in this section.

"Emergency permit" means a permit issued in accordance with section 66270.61.

"End-user" means (a) any person who receives a hazardous waste from an unaffiliated third party and who intends to, or does, use or reuse that waste as:

(1) an ingredient in an industrial process to make a product, provided that distinct components of the material are not recovered as separate end products; or

(2) a substitute for a raw material in a process that uses raw materials as principal feedstocks; or

(3) a substitute for a commercial product in a particular

function or application.
(b) "End-user" does not include:
(1) a person who receives a RCRA hazardous waste;
(2) a person who receives a hazardous waste from an unaffiliated third party and who intends to, or does, process that waste to recover usable products or regenerate that waste;
(3) a person managing a material that is not a waste pursuant to Health and Safety Code section 25143.2.

"EPA Acknowledgment of Consent" means the cable sent to the USEPA from the U.S. Embassy in a receiving country that acknowledges the written consent of the receiving country to accept the hazardous waste and describes the terms and conditions of the receiving country's consent to the shipment.

"EPA hazardous waste number" means the number assigned to each hazardous waste listed in article 4 of chapter 11 of this division and to each characteristic identified in article 3 of chapter 11 of this division as an EPA hazardous waste number.

"Equipment" means each valve, pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, or flange, and any control devices or systems required by these regulations.

"Equivalent method" means any testing or analytical method approved by the USEPA Administrator under 40 CFR sections 260.20 and 260.21 or by the Department under section 66260.21 of this division.

"Existing component" see "Existing tank system".

"Existing facility" see "Existing hazardous waste management facility".

"Existing hazardous waste facility" see "Existing hazardous waste management facility".

"Existing hazardous waste management (HWM) facility", "Existing hazardous waste facility", or "existing facility" means a facility which was in operation or for which construction commenced on or before November 19, 1980 and for which a Part A permit application has been submitted to the Department or the USEPA. A facility has commenced construction if:
(a) the owner or operator has obtained the Federal, State and local approvals or permits necessary to begin physical construction; and either
(b)(1) a continuous onsite, physical construction program has begun; or
(2) the owner or operator has entered into contractual obligations, which cannot be cancelled or modified without substantial loss, for physical construction of the facility to be completed within a reasonable time.

"Existing portion" means:
(a) that land surface area of an existing facility, included in the original RCRA Part A permit application, on

which wastes have been placed prior to February 2, 1985;

(b) for facilities that were not required to submit a RCRA permit application, that land surface area of an existing facility on which wastes have been placed prior to February 2, 1985.

"Existing tank system" or "existing tank component" means a tank system or component that is used for the transfer, storage or treatment of hazardous waste and that is in operation, or for which installation has commenced on or prior to the dates indicated below:

(a) July 14, 1986, for tanks containing RCRA hazardous wastes, unless:

(1) the owner/operator is a conditionally exempt small quantity generator as defined in 40 CFR section 261.5, or a 100 to 1,000 kg per month generator as defined in 40 CFR section 265.201, or

(2) the owner/operator is not subject to regulation in 40 CFR part 264 or part 265 pursuant to an exemption in 40 CFR section 264.1 or section 265.1;

(b) July 1, 1991 for:

(1) tanks containing only non-RCRA hazardous wastes, and

(2) tanks containing RCRA hazardous wastes, if:

(A) the owner/operator is a conditionally exempt small quantity generator as defined in 40 CFR section 261.5, or a 100 to 1,000 kg per month generator as defined in 40 CFR section 265.201, or

(B) the owner/operator is not subject to regulation in 40 CFR part 264 or part 265 pursuant to an exemption in 40 CFR section 264.1 or section 265.1, but the owner/operator is subject to the standards of article 10 of chapter 14 or article 10 of chapter 15 of this division.

Installation will be considered to have commenced if the owner or operator has obtained all Federal, State and local approvals or permits necessary to begin physical construction of the site or installation of the tank system and if either a continuous onsite physical construction or installation program has begun, or the owner or operator has entered into contractual obligations, which cannot be canceled or modified without substantial loss, for physical construction of the site or installation of the tank system to be completed within a reasonable time.

"Extremely hazardous material" means a substance or combination of substances which, if human exposure should occur, may likely result in death, disabling personal injury or serious illness caused by the substance or combination of substances because of its quantity, concentration or chemical characteristics.

"Extremely hazardous waste" means any hazardous waste or mixture of hazardous wastes which, if human exposure should occur, may likely result in death, disabling personal injury or serious illness caused by the hazardous waste or mixture of hazardous wastes because of its quantity, concentration or chemical characteristics.

"Facility" see "Hazardous waste facility".

"Facility mailing list" means the mailing list for a facility maintained by the Department in accordance with section 66271.9(c)(1)(D).

"Facility personnel" see "Personnel".

"Federal agency" means any department, agency or other instrumentality of the Federal Government, any independent agency or establishment of the Federal Government including any Government corporation, and the Government Printing Office.

"Federal, State and local approvals or permits necessary to begin physical construction" means permits and approvals required under Federal, State or local hazardous waste control statutes, regulations or ordinances.

"Final closure" means the closure of all hazardous waste management units at the facility in accordance with all applicable closure requirements so that hazardous waste management activities under chapters 14 and 15 of this division are no longer conducted at the facility unless subject to the provisions in section 66262.34.

"Fine powder" means a metal in dry, solid form having a particle size smaller than 100 micrometers (0.004 inches) in diameter.

"First attempt at repair" means to take rapid action to maintain compliance with Section 66265.31, for the purpose of stopping or reducing leakage of organic material to the atmosphere using best practices.

"Fixed Treatment Unit" means any equipment which performs a treatment as defined in this section and which is permanently stationed, or which is periodically assembled for use, at a single facility for the purpose of performing treatment, regardless of the period or frequency of treatment.

"Flame zone" means the portion of the combustion chamber in a boiler occupied by the flame envelope.

"Flow indicator" means a device that indicates whether gas flow is present in a vent stream.

"Food-chain crops" means tobacco, crops grown for human consumption and crops grown for feed for animals whose products are consumed by humans.

"Fractionation operation" means a distillation operation or method used to separate a mixture of several volatile components of different boiling points in successive stages, each stage removing from the mixture some portion of one of the components.

"Free liquids" means liquids which readily separate from the solid portion of a waste under ambient temperature and pressure. Free liquids are determined by using the paint filter test (EPA Method No. 9095), as modified in section 66264.314(b) of this division.

"Freeboard" means the vertical distance between the top of a tank or surface impoundment dike, and the surface of the waste contained therein.

"Functionally equivalent component" means a component which performs the same function or measurement and which meets or exceeds the performance specifications of another component.

"Generator" or "Producer" means any person, by site, whose act or process produces hazardous waste identified or listed in chapter 11 of this division or whose act first causes a hazardous waste to become subject to regulation.

"Groundwater" means water below the land surface in a zone of saturation.

"Halogenated organic compounds" or "HOCs" means those compounds having a carbon-halogen bond which are listed under Appendix III or Appendix III-A to chapter 18 of this division.

"Handling" means the transporting or transferring from one place to another, or pumping, processing, storing or packaging of hazardous waste, but does not include the handling of any substance before it becomes a waste.

"Hauler" means a transporter.

"Hazardous Constituent" means:

(a) a constituent identified in Appendix VIII to chapter 11 of this division; or

(b) any other element, chemical compound, or mixture of compounds which is a component of a hazardous waste or leachate and which has a physical or chemical property that causes the waste or leachate to be identified as a hazardous waste.

"Hazardous debris" means debris that contains a hazardous waste listed in article 4 of chapter 11 of this division, or that exhibits a characteristic of hazardous waste identified in article 3 of chapter 11.

"Hazardous material" is defined in Health and Safety Code Section 25501 as applied in Chapter 6.95 of Division 20 of the Health and Safety Code.

"Hazardous waste" means a hazardous waste as defined in section 66261.3 of this division. "Hazardous waste" includes extremely hazardous waste, acutely hazardous waste, RCRA hazardous waste, non-RCRA hazardous waste and special waste.

"Hazardous waste discharge" see "discharge".

"Hazardous waste constituent" means a constituent that caused the USEPA Administrator to list the hazardous waste in 40 CFR Part 261, Subpart D, or a constituent listed in Table 1 of 40 CFR Section 261.24.

"Hazardous waste facility," "hazardous waste management facility," "HW facility," or "facility" means:

(a) all contiguous land and structures, other appurtenances, and improvements on the land used for the treatment, transfer, storage, resource recovery, disposal or recycling of hazardous waste. A hazardous waste facility may consist of one or more treatment, transfer, storage, resource recovery, disposal or recycling operational units or combinations of those units.

(b) For the purpose of implementing corrective action under articles 6, 15.5, or 17 of chapter 14 or article 18 of chapter 15 of this division, all contiguous property under the control of the owner or operator seeking a permit under Title 22, Division 4.5 of the California Code of Regulations. This definition applies to all contiguous property of a owner or operator implementing corrective action at a facility under Health and Safety Code sections 25200.10 or 25187, or federal RCRA section 3008(h) [U.S.C. Title 42, section 6928(h)]. This definition also applies to all contiguous property of a owner or operator implementing removal or remedial action at an extra-large, large, medium, or small site where hazardous substances have been released or threaten to be released under Health and Safety Code sections 25187 or 25358.9 where as provided for under the provisions of that section the Department has excluded the removal or remedial action at a site from the hazardous waste facilities permit required by Health and Safety Code section 25201.

"Hazardous waste facility permit" or "permit" means an authorization, license or equivalent control document issued by the USEPA or the Department to implement the requirements of RCRA and this division. "Permit" includes permit by rule pursuant to section 66270.60, and emergency permit pursuant to section 66270.61.

"Hazardous waste management unit shutdown" means a work practice or operational procedure that stops operation of a hazardous waste management unit or part of a hazardous waste management unit. An unscheduled work practice or operational procedure that stops operation of a hazardous waste management unit or part of a hazardous waste management unit for less than 24 hours is not a hazardous waste management unit shutdown. The use of spare equipment and technically feasible bypassing of equipment without stopping operation are not hazardous waste management unit shutdowns.

"Permit" does not include interim status (article 7 of chapter 20), or any permit which has not yet been the subject of final USEPA or Department action, such as a draft permit or a proposed permit.

"Hazardous waste management" see Management".

"Hazardous waste management facility" see "Hazardous waste facility".

"Hazardous waste management unit" is a contiguous area of land on or in which hazardous waste is placed, or the largest area in which there is significant likelihood of mixing hazardous waste constituents in the same area. Examples of hazardous waste management units include a surface impoundment, a waste pile, a land treatment area, a landfill cell, a waste transfer area, an incinerator, a tank and its associated piping and underlying containment system and a container storage area. A container alone does not constitute a unit; the unit includes containers and the land or pad upon which they are placed.

"Hazardous waste property" means (a) land which is either of the following:

(1) any hazardous waste facility or portion thereof, required to be permitted pursuant to this division, which has a permit for disposal from the Department or has submitted an application for such a permit;

(2) a portion of any land designated as a hazardous waste property pursuant to Health and Safety Code section 25229 where a significant disposal of hazardous waste has occurred on, under or into the land resulting in a significant existing or potential hazard to present or future public health or safety.

(b) "Hazardous waste property" does not mean residential land that has never received waste chemicals from an industrial, commercial, agricultural, research or business activity.

"Highway" means a way, or place, of whatever nature open to the use of the public for purposes of vehicular travel. Highway includes street.

"HOCs" see "Halogenated organic compound".

"Hot well" means a container for collecting condensate as in a steam condenser serving a vacuum-jet or steam-jet ejector.

"Household" means a single detached residence or a single unit of a multiple residence unit and all appurtenant structures.

"Household hazardous waste" means any hazardous waste generated incidental to owning and/or maintaining a place of residence. Household hazardous waste does not include any waste generated in the course of operating a business at a residence.

"HWM facility" see "Hazardous waste facility".

"ID Number" see "Identification number".

"Identification Number" or "ID Number" means the number applied for by and assigned to all handlers of hazardous waste. A State ID number will be issued to handlers of non-RCRA hazardous waste (HW) and/or under 100 KG per calendar month of a RCRA HW. The State ID number will have a prefix of three letters followed by nine numbers. A federal ID number (EPA ID number) will be issued to handlers of 100 KG or more per calendar month of a RCRA HW and/or more than 1 KG per calendar month of acute HW, and any amount of non-RCRA HW. The federal ID number will have a prefix of three letters followed by nine numbers. Federal facilities will have a prefix of two letters followed by ten numbers.

"Ignitable" means capable of being set afire, or of bursting into flame spontaneously or by interaction with another substance or material.

"Impoundment" see "Surface impoundment".

"In gas/vapor service" means that the piece of equipment contains or contacts a hazardous waste stream that is in the gaseous state at the operating conditions.

"In heavy liquid service" means that the piece of equipment is not in either gas/vapor service or in light liquid service.

"In light liquid service" means that the piece of equipment contains or contacts a waste stream where the vapor pressure of one or more of the components in the stream is greater than 0.3 kilopascals (kPa) at 20 degrees C, the total concentration of the pure components having a vapor pressure greater than 0.3 kPa at 20 degrees C is equal to or greater than 20 percent by weight, and the fluid is a liquid at the operating conditions.

"In operation" refers to a facility which is transferring, treating, storing or disposing of hazardous waste.

"In situ sampling systems" means non-extractive samplers or in-line samplers.

"In vacuum service" means that equipment is operating at an internal pressure that is at least 5 kPa below ambient pressure.

"Inactive portion" means that portion of a facility which is not operated after November 19, 1980.

"Incinerator" means any enclosed device using controlled flame combustion that neither meets the criteria for classification as a boiler nor is listed as an industrial furnace.

"Incompatible waste" means a hazardous waste which is unsuitable for:

(a) placement in a particular device or facility because it may cause corrosion or decay of containment materials (e.g., container inner liners or tank walls); or

(b) commingling with another waste or material under uncontrolled conditions because the commingling might produce heat or pressure, fire or explosion, violent reaction, toxic dusts, mists, fumes, or gases or flammable fumes or gases. (See Appendix V to chapter 15 of this division for examples.)

"Independent sample" means an individual sample that has not been affected by previous sampling efforts.

"Independently audited" refers to an audit performed by an independent certified public accountant in accordance with generally accepted auditing standards.

"Individual generation site" means the contiguous site at or on which one or more hazardous wastes are generated. An individual generation site, such as a large manufacturing plant, may have one or more sources of hazardous waste but is considered a single or individual generation site if the site or property is contiguous.

"Industrial furnace" means any of the following enclosed devices that are integral components of manufacturing processes and that use controlled flame devices to accomplish recovery of materials or energy:

(a) cement kilns;

(b) lime kilns;

(c) aggregate kilns;

(d) phosphate kilns;
(e) coke ovens;
(f) blast furnaces;
(g) smelting, melting and refining furnaces (including pyrometallurgical devices such as cupolas, reverberator furnaces, sintering machines, roasters and foundry furnaces);
(h) titanium dioxide chloride process oxidation reactors;
(i) methane reforming furnaces;
(j) pulping liquor recovery furnaces;
(k) combustion devices used in the recovery of sulfur values from spent sulfuric acid;
(l) such other devices as the USEPA Administrator may, after notice and comment, add to the list of "industrial furnaces" in 40 CFR section 260.10 on the basis of one or more of the following factors:
(1) the design and use of the device primarily to accomplish recovery of material products;
(2) the use of the device to burn or reduce raw materials to make a material product;
(3) the use of the device to burn or reduce secondary materials as effective substitutes for raw materials, in processes using raw materials as principal feedstocks;
(4) the use of the device to burn or reduce secondary materials as ingredients in an industrial process to make a material product;
(5) the use of the device in common industrial practice to produce a material product; and
(6) other factors, as appropriate.

"Injection well" means any bored, drilled, or driven shaft, dug pit, or hole in the ground whose depth is greater than its largest surface dimension and any associated subsurface appurtenances, including, but not limited to, the casing.

"Inner liner" means a continuous layer of material placed inside a tank or container which protects the construction materials of the tank or container from the contained waste or reagents used to treat the waste.

"Installation inspector" means a person who, by reason of, that person's knowledge of the physical sciences and the principles of engineering, acquired by a professional education and related practical experience, is qualified to supervise the installation of tank systems.

"Interim status" means the authorization granted by the Department or the USEPA which allows a facility to continue to operate pending review and decision of the facility's permit application.

"International shipment" means the transportation of hazardous waste into or out of the jurisdiction of the United States.

"Land disposal" means placement in or on the land, except in a corrective action management unit, and includes, but is not limited to, placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, underground mine or cave or placement in a concrete vault or bunker intended for disposal purposes.

"Land disposal method" means:

(a) disposal of hazardous wastes on or into the land, including, but not limited to, landfill, surface impoundment, waste piles, deep-well injection, land spreading and co-burial with municipal garbage;

(b) treatment of hazardous wastes on or in the land, such as neutralization and evaporation ponds and land farming, where the treatment residues are hazardous wastes and are not removed for subsequent processing or disposal within one year;

(c) storage of hazardous wastes on or in the land, such as waste piles and surface impoundments, other than neutralization and evaporation ponds, for longer than one year.

"Landfill" means a disposal facility or part of a facility where hazardous waste is placed in or on land and which is not a pile, a land treatment facility, a surface impoundment, an underground injection well, a salt dome formation, a salt bed formation, an underground mine, a cave, or a corrective action management unit.

"Landfill cell" means a discrete volume of a hazardous waste landfill which uses a liner to provide isolation of wastes from adjacent cells or wastes. Examples of landfill cells are trenches and pits.

"Land treatment facility" means a facility or part of a facility at which hazardous waste is applied onto or incorporated into the soil surface so that hazardous constituents are degraded, transformed or immobilized within the treatment zone. Such facilities are disposal facilities if the waste will remain after closure.

"Leachate" means any liquid, including any suspended components in the liquid, that has percolated through or drained from hazardous waste.

For the purposes of chapters 14 and 15, "Leachate collection and removal system/leak detection system (LCRS/LDS)" means the liner system component that immediately underlies the uppermost liner of a waste management unit, and that serves both:

(a) as a leachate collection and removal system (LCRS), by collecting and conveying leachate to a sump for disposal; and

(b) as a leak detection system (LDS), by enabling the discharger to determine when the uppermost liner is leaking, by virtue of the leachate flow rate through the uppermost liner's exceeding the action leakage rate.

"Leak-detection system" means a system capable of detecting the failure of either the primary or secondary containment structure or the presence of a release of hazardous waste or accumulated liquid in the secondary containment structure. Such a system must employ operational controls (e.g., daily visual inspections for releases into the secondary containment system of aboveground tanks) or consist of an interstitial monitoring device designed to detect continuously and automatically the failure of the primary or secondary containment structure or the presence of a release of hazardous waste into the secondary containment structure.

"Legal defense costs" means any expenses that an insurer incurs in defending against claims of third parties brought under the terms and conditions of an insurance policy.

"Liabilities" means probable future sacrifices of economic benefits arising from present obligations to transfer assets or provide services to other entities in the future as a result of past transactions or events.

"License" includes, but is not limited to any permit, registration or certification issued by any local, State, or Federal agency for the generation, transportation, treatment, storage, recycling, disposal or handling of hazardous waste.

"Liner" means a continuous layer of natural or man-made materials, beneath or on the sides of a surface impoundment, landfill or landfill cell, which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

"Load" means the amount of waste transported by one truck, one railroad car or one barge to a hazardous waste facility.

"Major facility" means any facility or activity classified as such by the USEPA Regional Administrator in conjunction with the Department.

"Malfunction" means any sudden failure of a control device or a hazardous waste management unit or failure of a hazardous waste management unit to operate in a normal or usual manner, so that organic emissions are increased.

"Management" or "hazardous waste management" means the handling, storage, transportation, processing, treatment, recovery, recycling, transfer and disposal of hazardous waste.

"Manifest" means the shipping document DHS 8022A, or the equivalent document required by the state to which the waste will be shipped, which is originated and signed by the generator in accordance with the instructions included in the appendix to chapter 12 of this division.

"Manifest document number" means the unique number assigned to the manifest by the Department for recording and reporting purposes.

"Maximum credible earthquake" means the maximum earthquake which rationally appears capable of occurring under the presently known tectonic framework and all known geologic and seismologic facts. The following factors and standards shall be applied in determining the maximum credible earthquake:

(a) the seismic history of the vicinity and the geologic province;

(b) the length of the significant fault or faults which can affect the site within a radius of 100 kilometers;

(c) the type(s) of faults involved;
(d) the tectonic and/or structural history;
(e) the tectonic and/or structural pattern or regional setting (geologic framework);
(f) the time factor (known or expected frequency of occurrence) shall not be a parameter.

"Mining overburden returned to the mine site" means any material overlying an economic mineral deposit which is removed to gain access to that deposit and is then used for reclamation of a surface mine.

"Miscellaneous unit" means a hazardous waste management unit where hazardous waste is transferred, treated, stored, or disposed of and that is not a container, tank, surface impoundment, pile, land treatment unit, landfill, incinerator, boiler, industrial furnace, underground injection well with appropriate technical standards under article 5.5 commencing with section 25159.10 of chapter 6.5 of division 20 of the Health and Safety Code, containment building, corrective action management unit, or unit eligible for a research, development, and demonstration permit under section 66270.65.

"Monitoring parameter" means one of the set of parameters specified in the facility permit for which monitoring is conducted. Monitoring parameters shall include physical parameters, waste constituents, reaction products, and hazardous constituents, that provide a reliable indication of a release from a regulated unit.

"Monitoring point" means a well, device or location specified in the facility permit at which the water quality or environmental protection standard applies and at which monitoring is conducted.

"Movement" means that hazardous waste transported to a facility in an individual vehicle.

"National Pollutant Discharge Elimination System" means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 318, 402, and 405 of the Federal Water Pollution Control Act (33 U.S.C. sections 1317, 1328, 1342 and 1345). The term includes an approved program.

"Natural resources" includes, but is not limited to, disposal site capacity and substances which are hazardous waste, or which are in hazardous waste, the reuse of which is technologically and economically feasible.

"Net working capital" means current assets minus current liabilities.

"Net worth" means total assets minus total liabilities and is equivalent to owner's equity.

"New facility" see "New hazardous waste management facility".

"New hazardous waste facility" see "New hazardous waste management facility".

"New hazardous waste management facility", "new hazardous waste facility", or "new facility" means a facility which began operation, or for which construction commenced after November 19, 1980.

"New tank component" see "New tank system".

"New tank system" or "new tank component" means a tank system or component that will be used for the transfer, storage or treatment of hazardous waste and for which installation (as defined under "Existing tank system" in this section) has commenced after the dates indicated below; except, however, for purposes of sections 66264.193 (g) and 66265.193 (g), a new tank system is one for which construction commences after the dates indicated below: (See also "Existing tank system.")

(a) July 14, 1986, for tanks containing RCRA hazardous wastes, unless:

(1) the owner/operator is a conditionally exempt small quantity generator as defined in 40 CFR section 261.5, or a 100 to 1,000 kg per month generator as defined in 40 CFR section 265.201, or

(2) the owner/operator is not subject to regulation in 40 CFR part 264 or part 265 pursuant to an exemption in 40 CFR section 264.1 or section 265.1;

(b) July 1, 1991 for:

(1) tanks containing only non-RCRA hazardous wastes, and

(2) tanks containing RCRA hazardous wastes, if:

(A) the owner/operator is a conditionally exempt small quantity generator or a 100 to 1,000 kg per month generator, or

(B) the owner/operator is not subject to regulation in 40 CFR part 264 or part 265 pursuant to an exemption in 40 CFR section 264.1 or section 265.1, but the owner/operator is subject to the standards of article 10 of chapter 14 or article 10 of chapter 15 of this division.

"Non-RCRA hazardous waste" means all hazardous waste regulated in the State, other than RCRA hazardous waste as defined in this section. A hazardous waste is presumed to be a RCRA hazardous waste, unless it is determined pursuant to section 66261.101 that the hazardous waste is a non-RCRA hazardous waste.

"Nonsudden accidental occurrence" means an unforeseen and unexpected accident which takes place over time, involves continuous or repeated exposure and results in bodily injury, property damage or environmental degradation.

"Nonwastewaters" means, for the purposes of chapter 18 of this division, wastes that do not meet the criteria for wastewaters found in the definition of "wastewaters" in this section.

"Offsite" means any site which is not onsite.

"Offsite facility" means a hazardous waste facility that is not an onsite facility.

"Onground tank" means a device meeting the definition of "tank" in this section that is situated in such a way that the bottom of the tank is on the same level as the adjacent surrounding surface so that the external tank bottom cannot be visually inspected.

"Onsite" means the same or geographically contiguous property which may be divided by public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along, the right-of-way. Noncontiguous properties owned by the same person but connected by a right-of-way which that person controls and to which the public does not have access, is also considered onsite property.

"Onsite facility" or "Onsite hazardous waste facility" means a facility:

(a) at which a hazardous waste is generated and which is owned by, leased to, or under the control of, the generator of the waste; and

(b) which is located on the same or geographically contiguous property, on which the waste is produced, which may be divided by public or private right-of-way, provided the entrance and exit between the properties is at a cross-roads intersection, and access is by crossing as opposed to going along, the right-of-way. Noncontiguous properties owned by the same person but connected by a right-of-way which the person controls and to which the public does not have access, is also considered an onsite facility.

"Onsite hazardous waste facility" see "Onsite facility".

"Open burning" means the combustion of any material without the following characteristics.

(a) control of combustion air to maintain adequate temperature for efficient combustion;

(b) containment of the combustion-reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and

(c) control of emission of the gaseous combustion products. (See also "incineration" and "thermal treatment".)

"Open-ended valve or line" means any valve, except pressure relief valves, having one side of the valve seat in contact with process fluid and one side open to the atmosphere, either directly or through open piping.

"Operator" means the person responsible for the overall operation of a facility.

"Operating life" see "Active life".

"Owner" means the person who owns a facility or part of a facility.

"Owner or operator" means the owner or operator of any facility or activity subject to regulation under chapter 6.5 commencing with section 25100, division 20, Health and Safety Code.

"P-value" means the smallest significance level for which the null hypothesis would be rejected based on the data that was actually observed.

"Parent corporation" means a corporation which directly owns at least 50 percent of the voting stock of the corporation which is the facility owner or operator; the latter corporation is deemed a "subsidiary" of the parent corporation.

"Part A of Permit Application" or "Part All means an application to the Department or the USEPA for a permit to operate a hazardous waste facility. The application is described in section 66270.13.

"Part B of Permit Application" or "Part B" means the operation plan described in sections 66270.14 through 66270.23 for a hazardous waste facility.

"Partial closure" means the closure of a hazardous waste management unit in accordance with the applicable closure requirements of chapters 14 and 15 of this division at a facility that contains other active hazardous waste management units. For example, partial closure may include the closure of a tank (including its associated piping and underlying containment systems), landfill cell, surface impoundment, waste pile or other hazardous waste management unit, while other units of the same facility continue to operate or will be placed in operation in the future.

"PCBs" see "Polychlorinated biphenyls".

"Permanent household hazardous waste collection facility" or "PHHWCF" means a facility operated by a public agency or its contractor which:

(a) is operated in accordance with section 67450.25; and

(b) is permanently sited at a location.

"Permit" see "Hazardous waste facility permit".

"Permit-by-rule" means a provision of these regulations stating that a facility or activity is deemed to have a permit if it meets the requirements of the provision.

"Permitted facility" means a facility that has received a hazardous waste facility permit from the Department or the USEPA in accordance with section 25200 of the Health and Safety Code or RCRA.

"Persistent toxic substance" means a toxic substance that resists natural degradation or detoxification.

"Person" means an individual, trust, firm, joint stock company, business concern, corporation, including, but not limited to, a government corporation, partnership and association.

"Person" also includes any city, county, district, commission, the State or any department, agency or political subdivision thereof, any interstate body, and the Federal Government or any department or agency thereof to the extent permitted by law.

"Personnel" or "facility personnel" means all persons who work, at, or oversee the operations of, a hazardous waste facility, and whose actions or failure to act may result in noncompliance with the requirements of this division.

"Physical parameter" means any measurable physical characteristic of a substance including, but not limited to, temperature, electrical conductivity, pH and specific gravity.

"Physical construction" means excavation, movement of earth, erection of forms or structures, or similar activity to prepare a facility to accept hazardous waste.

"Pile" or "waste pile" means any noncontainerized accumulation of solid, nonflowing hazardous waste that is used for treatment or storage and that is not a containment building.

"Point of compliance" means a vertical surface located at the hydraulically downgradient limit, of a regulated unit, that extends through the uppermost aquifer.

"Point source" means any discernible, confined and discrete conveyance, including, but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

"Polychlorinated biphenyls" or "PCBs are halogenated organic compounds defined in accordance with 40 CFR 761.3.

"Postclosure plan" means the plan for postclosure care prepared in accordance with chapter 14 or chapter 15 of this division.

"POTW" see "Publicly owned treatment works".

"Pressure release" means the emission of materials resulting from the system pressure being greater than the set pressure of the pressure relief device.

"Primary Exporter" means any person who is required to originate the manifest for a shipment of hazardous waste in accordance with article 2 of chapter 12 of this division, which specifies a treatment, storage or disposal facility in a receiving country as the facility to which the hazardous waste will be sent and any intermediary arranging for the export.

"Process heater" means a device that transfers heat liberated by burning fuel to fluids contained in tubes, including all fluids except water that are heated to produce steam.

"Process vent" means any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank (e.g., distillate receiver, condenser, bottoms receiver, surge control tank, separator tank, or hot well) associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations.

"Processing" means treatment.

"Producer" see "Generator".

"Property Damage" means (a) an injury to property which deprives its owner of the benefit of the property by taking, withholding, deteriorating or destroying it.

(b) For the purposes of chapter 13, "property damage" means damage to or loss of tangible property.

"Publicly owned treatment works" or "POTW" means any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature which is owned by a "State" or "municipality" (as defined by 33 U.S.C. section 1362). This definition includes sewers, pipes or other conveyances only if they convey wastewater to a POTW providing treatment.

"R chart" (Range chart) means a control chart for evaluating the variability within a process in terms of the subgroup range R.

"RCRA hazardous waste" means all waste identified as a hazardous waste in Part 261 (commencing with section 261.1) of subchapter I of chapter 1 of Title 40 of the Code of Federal Regulations and appendices thereto.

"Reactive" means having properties of explosivity or of chemical activity which can be a hazard to human health or the environment.

"Receiving country" means a foreign country to which a hazardous waste is sent for the purpose of treatment, storage or disposal (except short-term storage incidental to transportation).

"Reclaimed" means that a material is processed to recover a usable product, or that it is regenerated. Examples are recovery of lead values from spent batteries and regeneration of spent solvents.

"Recyclable material" means a hazardous waste that is capable of being recycled, including, but not limited to, any of the following:

(a) a residue;

(b) a spent material, including, but not limited to, a used or spent stripping or plating solution or etchant;

(c) a material that is contaminated to such an extent that it can no longer be used for the purpose for which it was originally purchased or manufactured;

(d) a byproduct listed in section 66261.31 or section 66261.32;

(e) any retrograde material that has not been used, distributed or reclaimed through treatment by the original manufacturer or owner by the later of the following dates:

(1) one year after the date when the material became a retrograde material;

(2) if the material has been returned to the original manufacturer, one year after the material is returned to the original manufacturer.

"Recycled material" means a material which is used or reused or reclaimed.

"Regional Administrator" or "USEPA Regional Administrator" means the Regional Administrator for the EPA Region in which the facility is located, or that person's designee.

"Registered hazardous waste transporter" means a transporter registered with the Department to transport hazardous wastes.

"Regulated Unit" means:

(a) a permitted hazardous waste facility, which operates or operated:

(1) any surface impoundment, waste pile, land treatment unit or landfill that receives or has received hazardous waste after July 26, 1982; or

(2) any surface impoundment, waste pile, land treatment unit, or landfill that ceased receiving hazardous waste by July 26, 1982 which is required to comply with the requirements of article 6 of chapter 14 of this division pursuant to section 66264.90(a);

(b) an interim status hazardous waste facility which operates or operated:

(1) any surface impoundment, waste pile, land treatment unit, or landfill that receives or has received hazardous waste after November 19, 1980; or

(2) any surface impoundment, waste pile, land treatment unit, or landfill that ceased receiving hazardous waste by November 19, 1980 which is required to comply with the requirements of article 6 of chapter 15 of this division pursuant to section 66265.90(a).

"Release" means:

(a) Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment.

(b) "Release" does not include any of the following:

(1) Any release which results in exposure to persons solely within a workplace, with respect to a claim such exposed persons may assert against their employer.

(2) Emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel or pipeline pumping station engine.

(3) Release of source, byproduct, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act of 1954 (42 U.S.C. 2011, et seq.), if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under section 2210 of Title 42 of the United States Code or, for the purposes of section 104 of the federal act (42 U.S.C. 9604) or any other response action, any release of source byproduct, or special nuclear material from any processing site designated under section 7912(a)(1) or 7942(a) of Title 42 of the United States Code, which sections are a part of the Uranium Mill Tailings Radiation Control Act of 1978.

(d) The normal application of fertilizer, plant growth regulants and pesticides.

"Remediation waste" means all solid and hazardous wastes, hazardous substances, and all media (including groundwater, surface water, soils, and sediments) and debris, which contain listed hazardous wastes or which themselves exhibit a hazardous waste characteristic, that are managed for the purpose of implementing corrective action requirements under articles 6, 15.5, or 17 of chapter 14 or article 18 of chapter 15 of this division, Health and Safety Code Sections 25200.10 or 25187, or section 25358.9 where as provided for under the provisions of that section the Department has excluded the removal or remedial action at a site from the hazardous waste facilities permit required by Health and Safety Code section 25201, or federal RCRA Section 3008(h) [U.S.C. Title 42, Section 6928(h)]. For a given facility, remediation wastes may originate only from within the facility boundary, but may include waste managed in implementing Health and Safety Code Sections 25200.10 or 25187, or section 25358.9 where as provided for under the provisions of that section the Department has excluded the removal or remedial action at a site from the hazardous waste facilities permit required by Health and Safety Code section 25201, or federal RCRA section 3004(v) [U.S.C. Title 42, Section 6924(v)] or 3008(h) [U.S.C. Title 42, Section 6928(h)] for releases beyond the facility boundary.

"Repaired" means that equipment is adjusted, or otherwise altered, to eliminate a leak.

For the purposes of chapters 14 and 15, "Replacement unit" means a landfill, surface impoundment, or waste pile unit

(1) from which all or substantially all of the waste is removed, and

(2) that is subsequently reused to transfer, treat, store, or dispose of hazardous waste. "Replacement unit" does not apply to a unit from which waste is removed during closure, if the subsequent reuse solely involves the disposal of waste from that unit and other closing units or corrective action areas at the facility, in accordance with an approved closure plan or EPA or State approved corrective action.

"Representative sample" means a sample of a universe or whole (e.g., waste pile, lagoon, ground water) which can be expected to exhibit the average properties of the universe or whole.

"Residuals Repository" means a hazardous waste facility or part of a facility that is permitted to accept for land disposal only non-liquid, treated hazardous waste (as defined in Section 25179.3(1), Health and Safety Code). Non-liquid means non-liquid and containing less than 50 percent moisture by weight as determined in accordance with Section 66265.317 of this Division.

"Resource recovery facility" means an offsite hazardous waste facility whose principal method of hazardous waste management is the handling, recycling, treatment, use or reuse of recyclable material and which meets the requirements in chapter 16 of this division.

"Restricted hazardous waste" means any hazardous waste which is subject to land disposal restriction pursuant to

Health and Safety Code section 25179.6 or chapter 18 of this division.

"Retrograde material" means any hazardous material which is not to be used, sold or distributed for use in an originally intended or prescribed manner or for an originally intended or prescribed purpose and which meets any one or more of the following criteria:

(a)(1) has undergone chemical, biochemical, physical or other changes due to the passage of time or the environmental conditions under which it was stored;

(2) has exceeded a specified or recommended shelf life;

(3) is banned by law, regulation, ordinance or decree;

(4) cannot be used for reasons of economics, health or safety or environmental hazard.

(b) "Retrograde material" does not include material listed in section 66261.33 if either of the following conditions is met:

(1) the material is used in a manner constituting disposal and the material is not normally used in a manner constituting disposal;

(2) the material is burned for energy recovery and the material is not normally burned for energy recovery.

"Run-off" means any rainwater, leachate or other liquid that drains over land from any part of a facility.

"Run-on" means any rainwater, leachate or other liquid that drains over land onto any part of a facility.

"Saturated zone" or "zone of saturation" means that part of the earth's crust in which all voids are filled with water.

"Schedule of compliance" means a schedule of remedial measures included in a permit or order, including an enforceable sequence of interim requirements (for example, actions, operations or milestone events) leading to compliance with applicable law.

"Scrap metal" means (a) any one or more of the following, except as provided in subsection (b) of this section:

(1) manufactured, solid metal objects and products;

(2) metal workings, including cuttings, trimmings, stampings, grindings, shavings and sandings; or

(3) solid metal residues of metal production.

(b) "Scrap metal" excludes all of the following:

(1) lead-acid storage batteries, waste elemental mercury, and water-reactive metals such as sodium, potassium and lithium;

(2) magnesium borings, trimmings, grindings, shavings and sandings and any other forms capable of producing independent combustion;

(3) beryllium borings, trimmings, grindings, shavings, sandings and any other forms capable of producing adverse health effects or environmental harm in the opinion of the Department;

(4) any metal contaminated with a hazardous waste, such that the contaminated metal exhibits any characteristic of a

hazardous waste under article 3 of chapter 11 of this division;

(5) any metal contaminated with an oil that is a hazardous waste and that is free-flowing;

(6) sludges, fine powders, semi-solids and liquid solutions that are hazardous wastes.

"Semitrailer" means a vehicle designed for carrying persons, property or waste, used in conjunction with a motor vehicle, and so constructed that some part of its weight and that of its load rests upon, or is carried by, another vehicle.

"Sensor" means a device that measures a physical quantity or the change in a physical quantity, such as temperature, pressure, flow rate, pH, or liquid level.

"Separator tank" means a device used for separation of two immiscible liquids.

"Series A Resource Recovery Facility Permit" means a type of hazardous waste facility permit issued by the Department which grants the authority to operate a resource recovery facility that meets the criteria in section 66266.7.

"Series B Resource Recovery Facility Permit" means a type of hazardous waste facility permit issued by the Department which grants the authority to operate a resource recovery facility that meets the criteria in section 66266.8.

"Series C Resource Recovery Facility Permit" means a type of hazardous waste facility permit issued by the Department which grants the authority to operate a resource recovery facility that meets the criteria in section 66266.9.

"Site" means the land or water area where any facility or activity is physically located or conducted, including adjacent land used in connection with the facility or activity.

"Sludge" means any solid, semi-solid or liquid waste generated from a municipal, commercial or industrial wastewater treatment plant, water supply treatment plant or air pollution control facility exclusive of the treated effluent from a wastewater treatment plant.

"Small quantity commercial source" means a business which generates less than 100 kilograms of household waste, as defined in paragraph (1) of subdivision (b) of Section 261.4 of Title 40 of the Code of Federal Regulations, or which meets the criteria for conditionally exempt small quantity generators specified in Section 261.5 of Title 40 of the Code of Federal Regulations, or, if the hazardous waste is perchlorethylene, a business which generates less than 50 kilograms of hazardous waste per month and meets the criteria set forth in Sections 261.4 or 261.5 of Title 40 of the Code of Federal Regulations.

"Small quantity generator" means a generator who generates less than 1,000 kg of hazardous waste in a calendar month.

"Soil-pore liquid" means the liquid contained in openings between particles of soil in the unsaturated zone.

"Solid Waste Management Unit" means any unit at a hazardous waste facility from which hazardous constituents might migrate, irrespective of whether the units were intended for the management of wastes, including but not limited to: containers, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators and underground injection wells.

"Soluble threshold limit concentration" or "STLC" means the concentration of a solubilized and extractable bioaccumulative or persistent toxic substance which, if equaled or exceeded in a waste or waste extract determined pursuant to Appendix II of chapter 11 of this division renders the waste hazardous.

"Solvent extraction operation" means an operation or method of separation in which a solid or solution is contacted with a liquid solvent (the two being mutually insoluble) to preferentially dissolve and transfer one or more components into the solvent.

"Special waste" means a waste which is a hazardous waste only because it contains an inorganic substance or substances which cause it to pose a chronic toxicity hazard to human health or the environment and which meets all of the criteria and requirements of section 66261.122 and has been classified a special waste pursuant to section 66261.124.

"Spent material" is any material that has been used and as a result of contamination can no longer serve the purpose for which it was produced without processing.

"Start-up" means the setting in operation of a hazardous waste management unit or control device for any purpose.

"State/EPA Agreement" means an agreement between the Regional Administrator and the Department which coordinates EPA and State activities, responsibilities and programs.

"Steam stripping operation" means a distillation operation in which vaporization of the volatile constituents of a liquid mixture takes place by the introduction of steam directly into the charge.

"STLC" see "Soluble threshold limiting concentration".

"Storage" means the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of or stored elsewhere.

"Sudden accidental occurrence" means an unforeseen and unexpected accident which is not continuous or repeated in nature and results in bodily injury, property damage or environmental degradation.

"Substantial business relationship" means the extent of a business relationship necessary under applicable State law to make a guarantee contract issued incident to that relationship valid and enforceable. A substantial business relationship" must arise from a pattern of recent or ongoing business transactions, in addition the guarantee itself, such that a currently existing business relationship between the guarantor and the owner or operator is demonstrated to the satisfaction of the Department.

"Sump" means any pit or reservoir that meets the definition of tank and those troughs/trenches connected to it that serves to collect hazardous waste for transport to hazardous waste storage, treatment or disposal facilities.

For the purposes of chapters 14 and 15, "Sump" means any pit or reservoir that meets the definition of tank and those troughs/trenches connected to it that serve to collect hazardous waste for transport to hazardous waste storage, treatment or disposal facilities; except that as used in the landfill, surface impoundment, and waste pile rules, "sump" means any lined pit or reservoir that serves to collect liquids drained from a leachate collection and removal system or leak detection system for subsequent removal from the system.

"Surface impoundment" or "impoundment" means a facility or part of a facility which is a natural topographic depression, man-made excavation or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold an accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling, and aeration pits, ponds and lagoons.

"Surge control tank" means a pipe or storage reservoir sufficient in capacity to contain the surging liquid discharge of the process tank to which it is connected.

"Surplus material" means an unused raw material or commercial product obtained by a person who intended to use or sell it, but who no longer needs it, and who transfers ownership of it to another person for use in a manner for which the material or product is commonly used. Surplus material is excess material. Surplus material is neither of the following:

(a) a retrograde material as defined in this section;

(b) a recyclable material as defined in this section.

"Tangible net worth" means the tangible assets that remain after deducting liabilities; such assets would not include intangibles such as goodwill and rights to patents or royalties.

"Tank" means a stationary device, designed to contain an accumulation of hazardous waste which is constructed primarily of nonearthen materials (e.g., wood, concrete, steel, plastic) which provide structural support.

"Tank system" means a hazardous waste transfer, storage or treatment tank and its associated ancillary equipment and containment system.

"Temporary household hazardous waste collection facility" or "THHWCF" means a facility operated by a public agency which:

(a) is operated in accordance with section 66270.1(c)(1)(F);

(b) is operated at the same location no more than 12 times per calendar year and no more than once in any calendar month at the same location; and

(c) terminates operation within two days of commencing each session.

"Terminate" means to accept the last delivery of waste.

"The State" means the State of California.

"Thermal treatment" means the treatment of hazardous waste in a device which uses elevated temperatures as the primary means to change the chemical, physical, or biological character or composition of the hazardous waste. Examples of thermal treatment processes are incineration, molten salt, pyrolysis, calcination, wet air oxidation and microwave discharge. (See also "incinerator" and "open burning".)

"Thin-film evaporation operation" means a distillation operation that employs a heating surface consisting of a large diameter tube that may be either straight or tapered, horizontal or vertical. Liquid is spread on the tube wall by a rotating assembly of blades that maintain a close clearance from the wall or actually ride on the film of liquid on the wall.

"Total threshold limit concentration" or "TTLC" means the concentration of a solubilized, extractable and nonextractable bioaccumulative or persistent toxic substance which, if equaled or exceeded in a waste, renders the waste hazardous.

"Totally enclosed treatment facility" means a facility for the treatment of hazardous waste which is directly connected to an industrial production process and which is constructed and operated in a manner which prevents the release of any hazardous waste or any constituent thereof into the environment during treatment. An example is a pipe in which waste acid is neutralized.

"Toxic waste" means a hazardous waste designated as a toxic waste by the USEPA Administrator pursuant to 40 CFR section 261.11.

"Trailer" means a vehicle designed for carrying persons, property or waste on its own structure and for being drawn by a motor vehicle and so constructed that no part of its weight rests upon any other vehicle.

"Transfer" means the loading, unloading, pumping or packaging of hazardous waste. Transfer does not include loading, unloading, pumping or packaging of hazardous waste on the site where the hazardous waste was generated.

"Transfer facility" or "transfer station" means any transportation related facility including loading docks, parking areas, storage areas and other similar areas where shipments of hazardous waste are held and/or transferred during the normal course of transportation.

"Transfer station" see "Transfer facility".

"Transit country" means any foreign country, other than a receiving country, through which a hazardous waste is transported.

"Transport vehicle" means a motor vehicle or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (trailer, railroad freight car, etc.) is a separate transport vehicle.

"Transportable Treatment Unit" means any mobile equipment which performs a "treatment" as defined in this section and which is transported onto a facility to perform treatment and which is not permanently stationed at a single facility.

"Transportation" means the movement of hazardous waste by air, rail, highway or water.

"Transporter" means a person engaged in offsite transportation of hazardous waste by air, rail, highway, or water.

"Treatability study" means either of the following, but does not include the commercial treatment or disposal of hazardous waste:

(a) The application of a treatment process to a representative sample of hazardous waste to determine any of the following:

(1) Whether the hazardous waste can be effectively treated by the treatment process employed in the treatability study.

(2) What pretreatment, if any, is required.

(3) The optimal conditions and processing techniques required to achieve the desired treatment.

(4) The efficiency of a treatment process for a specific hazardous waste or wastes.

(5) The characteristics and volumes of residual from a particular treatment process.

(b) Liner compatibility, corrosion, or other material compatibility studies.

"Treatability study sample" means a small quantity of hazardous waste, of no more than 400 kilograms (kg), which will be subject to a treatability study.

"Treatment" means any method, technique, or process which changes or is designed to change the physical, chemical, or biological character or composition of any hazardous waste or any material contained therein, or removes or reduces its harmful properties or characteristics for any purpose including, but not limited to, energy recovery, material recovery or reduction in volume.

"Treatment zone" means a soil area of the unsaturated zone of a land treatment unit within which hazardous constituents and constituents of concern are degraded, transformed or immobilized. A treatment zone may not extend more than five feet below the initial surface and the base of the treatment zone shall be a minimum of five feet above the highest anticipated elevation of underlying groundwater.

"Truck" means a motor vehicle, excluding truck tractor, designed, used or maintained primarily for the transportation of property or waste.

"TTLC" see "Total threshold limiting concentration".

"Underground injection" means the subsurface emplacement of fluids through a bored, drilled or driven well; or through a dug well, where the depth of the dug well is greater than the largest surface dimension. (See also "injection well".)

"Underground source of drinking water" or "USDW" means an aquifer or its portion:

(a)(1) which supplies any public water system; or

(2) which contains a sufficient quantity of ground water to supply a public water system; and

(A) currently supplies drinking water for human consumption; or

(B) contains fewer than 10,000 mg/l total dissolved solids; and

(b) which is not an exempted aquifer.

"Underground tank" means a device meeting the definition of "tank" in this section which is substantially or totally beneath the surface of the ground.

"Underlying hazardous constituent" means any constituent listed in section 66268.48 of chapter 18. Table UTS -- Universal Treatment Standards, except zinc, which can reasonably be expected to be present at the point of generation of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard.

"Unfit-for-use tank system" means a tank system that has been determined through an integrity assessment or other inspection to be no longer capable of transferring, storing or treating hazardous waste without posing a threat of release of hazardous waste to the environment.

"Unsaturated zone," "Vadose zone," or "zone of aeration" means the zone between the land surface and the water table.

"United States" means the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa and the commonwealth of the Northern Mariana Islands.

"Uppermost aquifer" means the geologic format on nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer.

"Used or reused" means that a material is either:

(a) employed as an ingredient, including use as an intermediate, in an industrial process to make a product (for example, distillation bottoms from one process used as feedstock in another process). However, a material will not satisfy this condition if distinct components of the material are recovered as separate end products (as when metals are recovered from metal-containing secondary materials); or

(b) employed in a particular function or application as an effective substitute for a commercial product (for example, spent pickle liquor used as phosphorous precipitant and sludge conditioner in wastewater treatment).

"USEPA Administrator" or "Administrator" means the Administrator of the federal Environmental Protection Agency, or the Administrator's designee.

"USEPA Regional Administrator" see "Regional Administrator".

"Vacuum tank" means a cargo tank which has the capability of being subjected to a vacuum or a pressure for purposes of loading and unloading its contents.

"Vadose zone" see "Unsaturated zone".

"Vapor incinerator" means any enclosed combustion device that is used for destroying organic compounds and does not extract energy in the form of steam or process heat.

"Variance" means a deviation from a provision of this division and chapter 6.5 of the Health and Safety Code authorized pursuant to section 66260.210 or Health and Safety Code section 25143.

"Vehicle" means, except for purposes of the annual inspections and the issuance of certificates of compliance required by chapters 12 and 13 of this division, a device by which any person or property, including waste, may be propelled, moved or drawn, excepting a device moved exclusively by human power. For purposes of the annual inspections and the issuance of certificates of compliance required by chapters 12 and 13 of this division, "vehicle" means a device by which any person or property, including waste, may be propelled, moved or drawn upon a highway, excepting a device moved exclusively by human power or used exclusively upon stationary rails or tracks.

"Vented" means discharged through an opening, typically an open-ended pipe or stack, allowing the passage of a stream of liquids, gases, or fumes into the atmosphere. The passage of liquids, gases, or fumes is caused by mechanical means such as compressors or vacuum-producing systems or by process-related means such as evaporation produced by heating and not caused by tank loading and unloading (working losses) or by natural means such as diurnal temperature changes.

"Vessel" includes every description of watercraft, used or capable of being used as a means of transportation on the water.

"Volatile organic compound" means a compound which is a volatile organic compound according to Method No. 8240 in the Environmental Protection Agency Document No. Sw 846 (1982) or any equivalent, alternative method acceptable to the Department.

"Waste" means waste as defined in section 66261.2.

"Waste constituent" means a constituent that is reasonably expected to be in or derived from waste contained in a regulated unit.

"Waste pile" see "Pile".

"Wastewaters" means, for the purposes of chapter 18 of this division, wastes that contain less than one percent by weight total organic carbon (TOC) and less than one percent by weight total suspended solids (TSS), with the following exceptions:

(a) F001, F002, F003, F004, F005 wastewaters are solvent-water mixtures that contain less than one percent by weight TOC or less than 1% by weight total F001, F002, F003, F004, F005 solvent constituents listed in section 66268.41, Table CCWE;

(b) K011, K013, K014 wastewaters contain less than five percent by weight total organic constituents (TOC) and less than one percent by weight total suspended solids (TSS), as generated;

(c) K103 and K104 wastewaters contain less than four percent by weight TOC and less than one percent by weight TSS.

"Wastewater treatment unit" means a device which:

(a) is part of a wastewater treatment facility which is subject to regulation under either section 402 (33 U.S.C. section 1317) or 307(b) (33 U.S.C. section 1342) of the Federal Clean Water Act; and

(b) receives and treats or stores an influent wastewater which is a hazardous waste as defined in chapter 11 of this division, or that generates and accumulates a wastewater treatment sludge which is a hazardous waste as defined in chapter 11 of this division, or treats or stores a wastewater treatment sludge which is a hazardous waste as defined in chapter 11 of this division; and

(c) meets the definition of tank or tank system in this section.

"Water (bulk shipment)" means the bulk transportation of hazardous waste which is loaded or carried on board a vessel without containers or labels.

"Water reactive" means having properties of, when contacted by water, reacting violently, generating extreme heat, burning, exploding or rapidly reacting to produce an ignitable, toxic or corrosive mist, vapor or gas.

"Well" means any shaft or pit dug or bored into the earth, generally of a cylindrical form, and often walled with bricks or tubing to prevent the earth from caving in.

"Well injection": (See "underground injection".)

"IX-bar chart" means a control chart for evaluating the process level or subgroup differences in terms of the subgroup average.

"Zone of aeration" see "Unsaturated zone".

"Zone of engineering control" means an area under the control of the owner or operator that, upon detection of a hazardous waste release, can be readily cleaned up prior to the release of hazardous waste or hazardous constituents to ground water or surface water.

"Zone of saturation" see "Saturation zone".

NOTE: Authority cited: Sections 25141, 25150, 25158.1, 25158.4, 25159, 25159.5, 25179.6, 25187.7, 25200.10, 25204, 25218.3, 25316, 25355.5, 25356.9, 25358.3, 25358.9, 58004, and 58012, Health and Safety Code; and Section 58012, Governor's Reorganizational Plan Number 1 of 1991.

APPLICATION FOR HAZARDOUS WASTE RECLASSIFICATIONS, CONCURRENCES AND THE DESIGNATION AS A SPECIAL WASTE
(RG Document #62; Revision #2; Revision Date: August 12, 1994)

Section 66260.200. Title 22. California Code of Regulations(22 CCR) allows a generator to self classify their wastes or to apply to the Department for a concurrence with the classification. If a generator has an identified non-RCRA hazardous waste, they may apply to the Department to “reclassify” and manage the waste as nonhazardous pursuant to section 66260.200(f), 22 CCR or to classify and manage the waste as a “special waste”, pursuant to section 66261.124. 22 CCR.

Application procedures to initiate hazardous was reclassifications and concurrences are contained in section 66260.200(m), 22 CCR. Section 66261.124, 22 CCR, contains information on the application procedure necessary to obtain approval from the Department to designate a waste as a special waste. While there are no formal application forms which are required to be submitted to the Department, the regulations contain certain requirements for the types of information which must be included in the applications. These requirements include, but are not limited to:

1. The name and address of the applicant and if different, a billing address for receipt of the fee assessment required initiate the review process. Also the name of the contact person, the location of the waste, and a phone number of the generating facility.

2. A description of the waste including a physical description, quantities produced per unit time, a detailed description of the generating process or source, and current waste disposal method.

3. Information on the sampling of the waste including the name and address of the firm sampling the waste, the name(s) of the person(s) sampling the waste, dates and locations of sample collection and a description of the sampling methodology and sample handling and preservation procedures.

4. Testing laboratory information including the name, address, and certification number of the testing laboratory, the test methods used and references for locating these methods, the name(s) and qualifications of the person(s) testing the waste, the method for preparation of laboratory samples from field samples and information needed to identify each sample.

5. Laboratory analyses including results from all tests required by Chapter 11, Division 4.5, 22 CCR, and a listing of the waste’s constituents. For special waste applications, factual information on the origin of the waste must be provided which establishes that the waste meets the criteria and requirements of special wastes pursuant to section 66261.122(a) (1), (a)(2), and section 66261.122(b), 22 CCR. Results shall include analyses from a minimum of four representative samples as specified in Chapter 9 of “Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,” SW-846, 3rd Edition, U.S. Environmental Protection Agency, 1986.

6. For reclassification applications submitted pursuant to section 66261.200(f), the applicant must provide laboratory, modeling, or research data which shows that the waste possesses an inherent characteristic which causes it to pose an insignificant hazard to human health and safety, livestock, and wildlife.

7. Certification of the veracity of the information submitted, signed and dated by a person who is the responsible manager of the facility.

Upon receipt of the application by the Department, a fee of $9,017.00 per wastestream will be assessed by the Board of Equalization pursuant to Section 25205.8, California Health and Safety Code (CHSC). [*Note:* The aforementioned fee is applicable for the 1994-1995 fiscal year and is adjusted annually to reflect increases or decreases in the cost of living as measured by the Consumer Price Index for the United States. Section 25208.8(b). CHSC.]

See Also: No other references:

Pursuant to Section 66262.11, Tittle 22, California Code of Regulations (22 CCR), it is the generator's responsibility to determine if his waste is hazardous or nonhazardous by testing representative samples of the waste using the methods set forth in Chapter 11, Division 4.5, 22 CCR and/or applying knowledge of the hazardous characteristics of the waste in light of the materials or processes used to generate the waste. If the waste exhibits any of these characteristics, it is classified as a hazardous waste and must be managed as such. The classification of wastes is not to be confused with the establishment of cleanup levels. Waste classification determines only whether a waste must be managed as hazardous waste. To obtain further documents relating to the sampling and classification of wastes, call the waste evaluation helpline at (916) 322-7676. Copies of Division 4.5 Title 22, California Code of Regulations are available at most public libraries which contain a government publications section or are available for purchase by calling Barclays Law Publishers at (415) 244-6611.

California Environmental Protection Agency   Office of Scientific Affairs
Department of Toxic Substances Control   Waste Evaluation Unit
P.O. Box 806, Sacramento, California 95812 - 0806

EAS Waste Analysis Request Form

___ RUSH
Approved by ______________
WAA Start Date___N/A_____

EAS Sample #______________________________________ Date Sampled__2/13/95_____
HWM Requisition #______________Acct. #____328405_______________ Date Submitted__2/13/95____
Building #________Room #________RMMA? Yes___No X_____________ Date Completed __2/27/95___
Bottles Submitted_______2_____HWM Field Tech__Charles Hunt
Send results to:__Charles Hunt________________ L-Code___618
Comments__Product test requested by Dave Hieb of Plant Engineering.

SAMPLE FROM (Record volume of liquid waste in tank when sampled. NOT maximum capacity of tank).
___Retention Tank_____liters, Tank #___________, ___ Tuff tank______liters (1 gal. = 3.8L)
___Carboy, ___55 gal. Drum, ___ Other____
Process/Source generating the sample__Mainstream - Product - water based floor finish.

SAMPLE DESCRIPTION (Check all that apply)

_X_ Aqueous	___ Coolant - (specify below)	___ Soil
___ Base - (specify below)	___ Solvents- (specify below)	___ Sludge, solid
___ Acid - (specify below)	___ Oil - (specify below)	___ Photochemicals
___ Other - (specify below)	___ Silicon Fluid	___ UNKNOWN
___ 2 liquid phases	___ % (by volume)	Top / Bottom (circle one)

Composition (List all other components such as hexane, lacquer thinner, alcohol)
~ 45 % water, ~ 30 % acrylic emulsion, ~ 10% glycol ethers.

ANALYSES REQUESTED (Discuss with Environmental Analyst assigned to the area)

General Analyses	Rad Analyses	GC Analyses	GC-MS Analyses
_X_ pH/Normality	___ Gross Alpha & Beta*	___ Halogenated and	___ Volatiles
___ Anions	___ Tritium*	___ Aromatic Volatiles	___ Semi-Vols.
_X_ ppm oil	___ Gamma Spectroscopy	___ Non-halogenated Vols.	TCLP Organics
___ % oil		___ PCBs	___ Volatiles
___ Cyanide		___ TPHs	___ Semi-Vols.
___ Flashpoint			

* If only asking for alpha/beta or ^{3}H, fill out a Limited Radioisotope Certification form.

Metals Analyses

_X_ TTLC Metals	___ TTLC Hg	___ TTLC As	___ TTLC Se
___ STLC Metals	___ STLC Hg	___ STLC As	___ STLC Se
___ TCLP Metals	___ TCLP Metals	___ TCLP As	___ TCLP Se

TTLC/STLC Metals = Ag, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se, Tl, V, Zn
TCLP Metals = Ag, As, Ba, Cd, Cr, Pb, Se
Other Analyses____

I certify that the above information is correct and complete to the best of my knowledge
Generator Signature______________________ L-_618__Date___2/13/95
Generator Name (Print)___Charles Hunt______ Ext_29766_ Pager__01044

EAS Approval 1 ______________________________________ Date __2/27/95

Rev 15, 28JUL94 jilv ELAP Certification No. 1554 EAS (510) 424-4127

LAWRENCE LIVERMORE NATIONAL LABORATORY
Environmental-Analytical Sciences

Sample #: 9500372/C - FLOOR FINISH Sample type: TTLC
Lab Book #: EAS ICP NTBK VOL. 1 Pg 51 Sample Matrix: FLOOR FINISH

Date analyzed	Element	Analyst Initials	Method Number	Sample Conc.	Units	MDL
18-Feb-1995	Antimony	DGB	6010	ND	mg/kg	5.
18-Feb-1995	Barium	DGB	6010	ND	mg/kg	.2
18-Feb-1995	Beryllium	DGB	6010	ND	mg/kg	.1
18-Feb-1995	Cadmium	DGB	6010	ND	mg/kg	5
18-Feb-199S	Chromium	DGB	6010	ND	mg/kg	.5
18-Feb-1995	Cobalt	DGB	6010	ND	mg/kg	.5
18-Feb-1995	Copper	DGB	6010	2.	mg/kg	1.5
18-Feb-1995	Lead	DGB	6010	ND	mg/kg	2.
18-Feb-1995	Molybdenum	DGB	6010	ND	mg/kg	.6
18-Feb-1995	Nickel	DGB	6010	ND	mg/kg	2.
18-Feb-1995	*Potassium	DGB	6010	330.	mg/kg	20.
18-Feb-1995	Silver	DGB	6010	ND	mg/kg	1.
18-Feb-1995	Thallium	DGB	6010	ND	mg/kg	10.
18-Feb-1995	*Uranium	DGB	6010	ND	mg/kg	30.
18-Feb-1995	Vanadium	DGB	6010	ND	mg/kg	2.
18-Feb-1995	Zinc	DGB	6010	3.	mg/kg	1.

ND = Not Detected MDL Method Detection Limit

MDLs are estimated based on MDLs measured in dilute standard solutions.

The concentration determined for this element is in support of the Department of Energy performance objective for identification and management of mixed waste. These data are relevant only for a sample that has been known to be radioactive.

Comments:

Analyst Signature Date

EAS ANALYSIS REPORT
Lawrence Liver-more National Laboratory
Environmental-Analytical Sciences

Wet Chemistry Analyses

Generated: 02/13/95 @ 19:55:42

EAS Sample #1: 9500372

Requisition # or Field #: 3248-05

Analysis	EPA Method	Lab Book Reference	Result	MDL *	Units	Date Completed	Analyst
pH	9040	PH4, 118	7.8			02/13/1995	BLIM

Comments____

* Method Detection Limit

______________________ 2/13/95
Lead Chemist's Approval Date

FGL ENVIRONMENTAL
ANALYTICAL CHEMISTS

February 22, 1995 LAB No: SP 501046-7

Lawrence Livermore National Laboratory
P.O. Box 808
Livermore , CA 94550

RE: Inorganic Analysis

Sample Site: EAS/EMAD
Description: 9500372A Water
Sampled by :
Type of Sample: Waste Water

Sampled: February 13, 1995
Received: February 15, 1995
Completed: February 17, 1995
QA/QC ID#: 50104607-

Analytical Results

CONSTITUENT	EPA METHOD	UNITS	DLR	RESULTS
Oil and Grease	**413.1**	**mg/L**	**3**	**820**

DLR = Detection Limit for Reporting Purposes. ND = Not Detected at or above the DLR.
ug/L = micrograms Per Liter (ppb) mg/L = Milligrams Per Liter (ppm) mg/kg = Milligrams Per Kilogram
* = DLR adjusted because of dilutions, concentrations, or limited sample.
Preservatives: (t) Cool 4 degrees Containers: (a) glass

If you have any questions, please call.

FGL ENVIRONMENTAL

Kurt Wilkinson, B.S.
Inorganic Lab Manager

Darrell H. Nelson, B.S.
Laboratory Director

KW/DHN:c

Corporate Offices & Laboratory
P.O. Box 272853
Santa Paula, CA 93051-0272
TEL: 805/659-0910
FAX: 805/525/4172

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FAX: 209/942-0423

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Visalia, CA
TEL: 209/734-9473
FAX: 209/734-8475
Mobile: 209/737-2399

TABLE 9-1. BASIC STATISTICAL TERMINOLOGY APPLICABLE TO SAMPLING PLANS FOR SOLID WASTE

Terminology	Symbol	Mathematical equation		(Equation)
• Variable (e.g., barium or endrin)	x	____		
• Individual measurement of variable.	x_i	____		
• Mean of all possible measurements of variable (population mean)	μ	$\mu = \dfrac{\sum_{i=1}^{N} x_i}{N}$	with N = number possible measurements	(1)
• Mean of measurements generated by sample (sample mean)	$\bar{x}$	Simple random sampling and systematic random sampling		
		$\bar{x} = \dfrac{\sum_{i=1}^{n} x_i}{n}$,	with n = number of sample measurements	(2a)
			Stratified random sampling	
		$\bar{x} = \sum_{k=1}^{r} W_k \bar{x}_k$,	with $\bar{x}_k$ = stratum mean and W_k = fraction of population represented by Stratum k (number of strata [k] range from 1 to r)	(2b)
• Variance of Sample	s^2	Simple random sampling and systematic random sampling		
		$s^2 = \dfrac{\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2/n}{n-1}$		(3a)
		Stratified random sampling		
		$s^2 = \sum_{k=1}^{r} w_k s_k^2$,	with s_k^2 = stratum variance and w_k = fraction of population represent by Stratum k (number of strata [k] ranges from 1 to r)	(3b)

Table 9-1. (Continued)

Terminology (Equation)	Symbol	Mathematical Equation	
• Standard deviation of sample.	s	$s = \sqrt{s^2}$	(4)
• Standard error (also standard error of mean and standard deviation of mean) of sample	$s_{\bar{x}}$	$s_{\bar{x}} = \frac{s}{\sqrt{n}}$	(5)
• Confidence interval	CI	$CI = \bar{x} \pm t_{.20}\, s_{\bar{x}}$, with $t_{.20}$ obtained from Table 2 for appropriate degrees of freedom.	(6)
• Regulatory threshold[a]	RT	Defined by EPA (e.g., 100 ppm for barium in elutriate of EP toxicity)	(7)
• Appropriate number of samples to collect from a solid waste (financial constraints not considered)	n	$n = \frac{t^2_{.20} s^2}{\Delta^2}$, with $\Delta = RT - \bar{x}$	(8)
• Degrees of freedom	df	$df = n - 1$	(9)
• Square root transformation	---	$x_i + 1/2$	(10)
Arcsine transformation	---	Arcsine p; if necessary, refer to any text on basic statistics; measurements must be converted to percentages (p)	(11)

[a]The upper limit of the CI for μ is compared with the applicable regulatory threshold (RT) to determine if a solid waste contains the variable (chemical contaminant) of concern at a hazardous level. The contaminant of concern is not considered to be present in the waste at a hazardous level if the upper limit of the CI is less than the applicable RT. Otherwise, the opposite conclusion is reached.

TABLE 9-2. TABULATED VALUES OF STUDENT'S “t” FOR EVALUATING SOLID WASTES

Degrees of freedom (n-l)[a]	Tabulated “t” value[b]
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.393
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289
	1.282

[a]degrees of freedom (df) are equal to the number of samples (n) collected from a solid waste less one.

[b]tabulated 't' values are for a two-tailed confidence interval and a probability of 0.20 (the same values are applicable to a one-tailed confidence interval and a probability of 0.10).

Revision 0
Date September 1986

BOX 1. STRATEGY FOR DETERMINING IF CHEMICAL CONTAMINANTS OF SOLID WASTES ARE PRESENT AT HAZARDOUS LEVELS - SIMPLE RANDOM SAMPLING

Step	General Procedures

1. Obtain preliminary estimates of $\bar{x}$ and s^2 for each chemical contaminant of a solid waste that is of concern. The two above-identified statistics are calculated by, respectively, Equations 2a and 3a (Table 9-1).

2. Estimate the appropriate number of samples (n_1) to be collected from the waste through use of Equation 8 (Table 9-1) and Table 9-2. Derive individual values of n_1 for each chemical contaminant of concern. The appropriate number of samples to be taken from the waste is the greatest of the individual values.

3. Randomly collect at least n_1 (or $n_2 - n_1$, $n_3 - n_2$, etc., as will be indicated later in this box) samples from the waste (collection of a few extra samples will provide protection against poor preliminary estimates of $\bar{x}$ and s^2). Maximize the physical size (weight or volume) of all samples that are collected.

4. Analyze the n_1 (or $n_2 - n_1$, $n_3 - n_2$ etc.) samples for each chemical contaminant of concern. Superficially (graphically) examine each set of analytical data for obvious departures from normality.

5. Calculate $\bar{x}$, s2, the standard deviation (s), and $s_{\bar{x}}$ for each set of analytical data by, respectively, Equations 2a, 3a, 4, and 5 (Table 9-1).

6. If $\bar{x}$ for a chemical contaminant is equal to or greater than the applicable RT (Equation 7, Table 9-1) and is believed to be an accurate estimator of μ, the contaminant is considered to be present in the waste at a hazardous concentration, and the study is completed. Otherwise, continue the study. In the case of a set of analytical data that does not exhibit obvious abnormality and for which $\bar{x}$ is greater than s_2, perform the following calculations with nontransformed data. Otherwise, consider transforming the data by the square root transformation (if $\bar{x}$ is about equal to s^2) or the arcsine transformation(if $\bar{x}$ is less than s^2) and performing all subsequent calculations with transformed data. Square root and arcsine transformations are defined by, respectively, Equations 10 and 11 (Table 9-1).

7. Determine the CI for each chemical contaminant of concern by Equation 6 (Table 9-1) and Table 9-2. If the upper limit of the CI is less than the applicable RT (Equations 6 and 7, Table 9-1), the chemical contaminant is not considered to be present in the waste at a hazardous concentration and the study is completed. Otherwise, the opposite conclusion is tentatively reached.

Revision 0
Date September 1986

8. If a tentative conclusion of hazard is reached, reestimate the total number of samples (n_2) to be collected from the waste by use of Equation 8 (Table 9-1) and Table 9-2. When deriving n_2, employ the newly calculated (not preliminary) values of x and S_2. If additional n_2 - n_1 samples of waste cannot reasonably be collected, the study is completed, and a definitive conclusion of hazard is reached. Otherwise, collect extra n_2 - n_1 samples of waste.

9. Repeat the basic operations described in Steps 3 through 8 until the waste is judged to be nonhazardous or, if the opposite conclusion continues to be reached, until increased sampling effort is impractical.

Florida M. Matthews

Report: STLC/TCLP Analysis

January 14, 1993

MOPPED WATER % SOLIDS

Mopped water samples:

9202994	9202995	9202989	9209996	9202997
9202998	9203000	9203001		

were analyzed for % solids.

Procedure used was the same as for STD STLC/TCLP procedure that is used for EPA method: If the waste water is a liquid containing less than five-tenth (0.5) percent by weight or undissolved solids, it shall not be subject to the WET test.

These samples appeared to have more than 0.5 percent solids.

The initial procedure is as follows:
Samples were shaken vigorously, fifty mls were taken from each sample, placed in a centrifuge tube, centrifuged at 4200 rpm's for 1 hr.
The liquid layer of the samples were filtered through pre-filters and 0.45 micron glass filter paper, supernatant collected and measured.
The solids from centrifuging were weighed, dried, and weighed after drying to determine evaporation and % solids. The filter papers were dried and weighed for the solids on the filter paper to be added to the weight determined from the dry centrifuging solids for total solids.

Samples	% solid	Total Solids (g) in 50 ml sample
9202994	11.56	5.78
9202995	5.92	2.96
9202989	1.66	0.83
9202996	4.72	2.36,
9202997	0.42*	0.21
9202998	1.34	1.79
9203000	7.76	3.88
9203001	3.82	1.91

* Not subject to Wet test.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, DC. 20460

OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: Sampling Issues Concerning SW-846 Chapter Nine

FROM: Ollie Fordham
National Inorganic Methods Program Manager for RCRA

TO: Charles Hunt
Lawrence Livermore Laboratory

DATE: April 25, 1995

This memo is a follow up on our telephone conversation of earlier today concerning statistical analysis of environmental data.

(1) The arc-sine transformation and the square root transformation are not normally appropriate for the statistical analysis of environmental data. As a general recommendation, the normal and lognormal distributions are the best representations of most environmental data and probably cover 99% of all cases. The statistical distribution must model the real distribution of the analyte or you are just “playing with numbers." The arc-sine distribution would only model events that follow a sinusoidal pattern.

(2) The log-transformation is often the most appropriate model for natural systems. it is recommended by OSW’s in its “RCRA Ground-water Monitoring: Technical Guidance Manual.” The Land correction to this transformation, while statistically correct, is mathematically intensive and usually does not have a significant impact on the final result. It is generally not needed.

TOXICITY

(Rg Document #54; Revision #1; Revision Date: August 19, 1993)

The toxicity characteristic contained in section 66261.24, Title 22, California Code of Regulations (22 CCR), establishes threshold limit values for a list of regulated inorganic and organic constituents. In section 66261.24(a)(1)(B), 22 CCR, there is the list of federally regulated constituents and their corresponding soluble threshold values as measured by the Toxicity Characteristic Leaching Procedure. In sections 66261.24(a)(2)(A) and 66261.24(a)(2)B, 22 CCR, there is the list of State regulated constituents and their corresponding total and soluble threshold values. The Department requires a separate and different extraction procedure to determine compliance with the State soluble threshold values. The procedure is known as the Waste Extraction Test.

Regulatory levels for acute oral, dermal, or inhalation toxicity have also been established in California and are contained in sections 66261.24(a)(3) through (a)(5), 22 CCR. The acute oral LD_{50} threshold is established at <5,000 mg/kg when the dose is given in a single administration using rats as the test species. The acute dermal LD_{50} threshold is established at <4,300 mg/kg when the dose is applied continuously for 24 hours using rabbits as the test species. The acute inhalation LC_{50} threshold is established at <10,000 ppm as a gas or vapor when inhaled continuously for 8 hours using rats as the test species. In the absence of data in the scientific literature, the Department may request that acute toxicity testing be performed if there is reason to believe that the acute toxicity of the waste may present a hazard to public health or the environment.

Section 66261.24(c)22 CCR, contains a provision which enables the generator to consider the additive toxicity of individual constituents identified as toxic according to sections 66261.24(a)(3) through 66261.24(a)(5), 22 CCR, in a waste. The equation may be used not only if a waste contains more than one toxic substance, but also to determine the toxicity of substances which are in the wastestream at <100%.

Another criteria to determine whether a waste is toxic is the aquatic toxicity test, contained in section 66261.24(a)(6) 22 CCR. The test species used are either fathead minnows, golden shiners, or rainbow trout. If the test results indicate an aquatic 96-hour LC_{50} < 500 mg/I, then the waste is considered toxic.

Chronic toxicity can be identified by the presence of any of the 16 listed carcinogens contained in section 66261.24(a)(7) 22 CCR, equal to or in excess of the regulatory threshold of 0.001% by weight. Toxicity can also be identified if the waste has been shown through experience or testing to pose a hazard to human health or the environment due to its carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistence in the environment, pursuant to section 66261.24(a)(8), 22 CCR.

See Also: TCLP vs. WET

Pursuant to Section 66262.11, Tittle 22, California Code of Regulations (22 CCR), it is the generator's responsibility to determine if his waste is hazardous or nonhazardous by testing representative samples of the waste using the methods set forth in Chapter 11, Division 4.5, 22 CCR and/or applying knowledge of the hazardous characteristics of the waste in light of the materials or processes used to generate the waste. If the waste exhibits any of these characteristics, it is classified as a hazardous waste and must be managed as such. The classification of wastes is not to be confused with the establishment of cleanup levels. Waste classification determines only whether a waste must be managed as hazardous waste. To obtain further documents relating to the sampling and classification of wastes, call the waste evaluation helpline at (916) 322-7676. Copies of Division 4.5 Title 22, California Code of Regulations are available at most public libraries which contain a government publications section or are available for purchase by calling Barclays Law Publishers at (415) 244-6611.

California Environmental Protection Agency
Department of Toxic Substances Control
P.O. Box 806, Sacramento, California 95812 - 0806

Office of Scientific Affairs
Waste Evaluation Unit

Total Waste Management System
Hazardous Requisition Screen Dump Report

Requisition: H118510	Building: 612	Profile:
Container ID: H118510	Room: 612-PT	Directorate: Plant Eng.
Hold Flags:	RMMA: No	<u>Hazardous Properties</u>:
Cont:	WAA: 612	Toxic: No
Item	Workplace end date: 01/29/93	Corrosive: No
Waste Run Date:	Waste Min:	Reactive: No
Load Date 01/29/93	Efforts: No	Waste Type Non-Haz
Unload Date 01/29/93	W1:	PCB:
Void Req Date:	W2	Waste Form: Liquid
Waste Run: HWM	W3	Container Type: Tank-fixed
GENERATED WASTE	W4	Container Size: 5000 gal
Sewer:		Container Composition:
Date:	Current Year: N	Waste Min Comments:
ID:		
RSDR: 0		

RMMA Waste:	Generator:	Inspector:
Kept Isolated:	Name: Jones, Collin	Name: Unknown
Exposed:	Emp Number: 450258	Emp Num: 000000
Prevention Comments:	Date: 01/29/93	01/01/99

Entered By: Davis	Compatibility Code: zzz
Entered Date: 02/05/93	Dept: STORAGE FACILITIES
Updated by:	HWM Req Approval:
Updated Date:	Name: LIGETI, OLGA
	Emp Num: 530768
Completed: Yes	Date: 04/19/93

Item: 1	How Many: 1	Sample No.: 93000286

Source: A940
Description: MOP WATER CONTAINING Pb IN TRACE AMOUNTS FROM THE FOLLOWING REQ'S: H111155, H111160, H112981, H112986, H112981, H118318, H118323, H118528, H111156, H111161, H112823, H112982, H112987, H118314, H118319, H118324, H118529, H111157, H112820, H112824, H112983, H112988,

Prefix: U	RCH: 6B	P: N	Orgn: 1	Form: B119:	EPA:
DTSC:	MSDS	Waste Flashpoint: No			
Toxic:	Corrosive:	Ignitable:		Reactive:	

Container ID: H118510-0001 Disposition: Outer Status:

Sequoia Analytical
680 Chesapeake Drive
Redwood City, CA 94063
(415) 364-9600 FAX (415) 364-9233

International Technology Corp
055 Junction Avenue
San Jose, CA 96131
Attention: Moshen Barazi

Client Project ID: LLNL/150944
Sample Description: H118510
Analysis Method: See Below
Lab Number: 3D3-0501

Sampled: 4/8/93
Received: 4/8/93

Reported: 4/13/93

STATIC ACUTE HAZARDOUS WASTE BIOASSAY

Static:	X	Species:	Pimephales promelas		
Cont Flow	_	Common Name:	Fathead Minnow		
		Mean Length:	22 mm	Min. Length: 20	
Screening	_	Mean weight:	0.10 g	Min weight: 0.060	
Definitive	X	Supplier:	Sticklebacks Unlimited	Max weight: 0.15	

Organisms/Tank:	10	Acclimation Temp:	19 Degrees C
Replicates:	2	Dilution Water:	Synthetic Softwater
Organisms/Conc.:	20	Tank Depth	13 cm
Tank Volume:	10 L		

	Alkalinity, mg/L		Hardness, mg/L	
	Initial	Final	Initial	Final
Control	28	31	42	45
1000 ppm	33	34	45	45
Duplicate: 1000 ppm	34	34	48	44

	Initial			24 Hours				48 Hours				72 Hours				96 Hours				
Date	4/9/93			4/10/93				4/11/93				4/12/93				4/13/93				
	DO mg/L	C Temp	pH Units	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	Total Dead
Control	9.8	19	7.6	9.1	19	7.2	0	8.7	19	7.0	0	8.4	18	7.3	0	8.2	18	7.1	0	0
100 ppm	9.8	19	7.8	9.1	19	7.3	0	8.6	19	7.1	0	8.4	18	7.2	0	7.9	18	7.0	0	0
180 ppm	9.9	19	8.0	9.0	19	7.3	0	8.4	19	7.1	0	7.9	18	7.1	0	7.7	18	7.0	0	0
320 ppm	10.2	19	8.2	9.1	19	7.4	0	8.4	19	7.1	0	7.8	18	7.0	0	7.5	18	6.9	0	0
560 ppm	10.2	19	8.5	8.9	19	7.5	0	7.7	19	7.1	0	7.2	18	6.9	0	7.1	18	6.9	0	0
1000 ppm	10.3	19	8.7	8.8	19	7.6	0	7.6	19	7.1	0	7.0	18	7.0	0	7.0	18	6.9	0	0

Duplicate	DO mg/L	C Temp	pH Units	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	DO mg/L	C Temp	pH Units	# M. Dead	Total Dead
Control	9.8	19	7.6	9.1	19	7.2	0	8.7	19	7.0	0	8.4	18	7.3	0	8.2	18	7.1	0	0
100 ppm	9.8	19	6.8	9.1	19	7.3	0	8.5	19	7.1	0	8.3	18	7.1	0	8.0	18	7.0	0	0
180 ppm	9.9	19	8.0	8.9	19	7.4	0	8.3	19	7.1	0	7.9	18	7.1	0	7.6	18	7.0	0	0
320 ppm	10.3	19	8.3	9.2	19	7.6	0	8.4	19	7.1	0	7.6	18	7.0	0	7.6	18	6.9	0	0
560 ppm	10.3	19	8.5	9.1	19	7.7	0	8.0	19	7.1	0	7.1	18	6.9	0	7.3	18	6.8	0	0
1000 ppm	10.3	19	8.8	8.7	19	7.8	0	7.6	19	7.1	0	7.0	18	7.0	0	7.2	18	6.9	0	0

LC - 50: $\geq$ 1,000 ppm
LC - 50 Dup: $\geq$ 1,000 ppm

LC - 50 Calculation Method: Moving average angle.

Remarks: ____

Analyst: D. George / N. Northey

Method Reference: Static Acute Bioassay Procedures for Hazardous Waste Samples, September 1987, California Department of Fish and Game WPCL

SEQUOIA ANALYTICAL

TOD GRANICHER
Project Manager

3D3-0501.ITJ <1>

METALS ANALYSIS

LAWRENCE LIVERMORE NATIONAL LABORATORY

Environmental - Analytical Sciences

Sample 9300286

Lab Book # SL1 PAGE 101

Date Analyzed	Element	Analyst Initials	Method Number	Method Concentration	Units	Detection Limits
2-8-1993	Beryllium	SPL	6010	ND	mg/L	.003
2-8-1993	Zinc	SPL	6010	190.	mg/L	.07
2-8-1993	Cadmium	SPL	6010	.25	mg/L	.02
2-8-1993	Antimony	SPL	6010	ND	mg/L	.6
2-8-1993	Nickel	SPL	6010	.35	mg/L	.003
2-8-1993	Copper	SPL	6010	3.6	mg/L	.007
2-8-1993	Manganese	SPL	6010	.60	mg/L	.005
2-8-1993	Molybdenum	SPL	6010	.45	mg/L	.02
2-8-1993	Cobalt	SPL	6010	.09	mg/L	.02
2-8-1993	Silver	SPL	6010	.064	mg/L	.006
2-8-1993	Lead	SPL	6010	4.6	mg/L	.05
2-8-1993	Vanadium	SPL	6010	.11	mg/L	.009
2-8-1993	Thallium	SPL	6010	.03	mg/L	.01
2-8-1993	Barium	SPL	6010	.93	mg/L	.001
2-8-1993	Chromium	SPL	6010	1.1	mg/L	.005

ND = Not Detected

Comments: TTLC

Analyst: Susan Letendre 2-10-93

Robert Lim 2-10-93

METALS ANALYSIS

LAWRENCE LIVERMORE NATIONAL LABORATORY

Environmental - Analytical Sciences

Sample 9300286STLC

Lab Book # SL1 PAGE 102

Date Analyzed	Element	Analyst Initials	Method Number	Method Concentration	Units	Detection Limits
03-04-1993	Beryllium	SPL	6010	ND	mg/L	.003
03-04-1993	Zinc	SPL	6010	99.	mg/L	.07
03-04-1993	Cadmium	SPL	6010	.1	mg/L	.02
03-04-1993	Antimony	SPL	6010	ND	mg/L	.6
03-04-1993	Nickel	SPL	6010	.11	mg/L	.003
03-04-1993	Copper	SPL	6010	2.0	mg/L	.007
03-04-1993	Manganese	SPL	6010	.24	mg/L	.005
03-04-1993	Molybdenum	SPL	6010	.2	mg/L	.02
03-04-1993	Cobalt	SPL	6010	..03	mg/L	.02
03-04-1993	Silver	SPL	6010	ND	mg/L	.006
03-04-1993	Lead	SPL	6010	1.7	mg/L	.05
03-04-1993	Vanadium	SPL	6010	..05	mg/L	.009
03-04-1993	Thallium	SPL	6010	ND	mg/L	.01
03-04-1993	Barium	SPL	6010	1.4	mg/L	.001
03-04-1993	Chromium	SPL	6010	< .005	mg/L	.005

ND = Not Detected

Comments: STLC Analysis

Analyst: Susan Letendre 3-8-93

Robert Lim 3-8-93

EAS ANALYSIS REPORT
LAWRENCE LIVERMORE NATIONAL LABORATORY
Environmental-Analytical Sciences

Sample #: 9300286

Requisition # or Field #:

Analysis	EPA Method	Lab Book Reference	Result	Units	Date Completed
pH	9040	pH3, 126	10.46		2-01-93

Comments:

________________	2-5-93	________________	2-5-93
Analyst Signature	Date	Supervisor’s Signature	Date

RCA

SURVEY:
PORTABLE WASTE CONTAINERS
GREATER THAN 55 GALLONS
USED AT LAWRENCE LIVERMORE
NATIONAL LABORATORY

Job Title__________________
Current Job Assignment __________________

DIRECTIONS: Please circle the letter in front of the response that best matches your experience. There maybe multiple correct answers. If you have never had any exposure to a particular portable tank or situation, please mark N/A.

1 What type of waste do you handle most frequently?
a hazardous
b non-hazardous. (If the waste is only radioactive, please circle 'b'.)

2 Please rank the following containers, 1 through 5 based on frequency of use. Number 1 representing the tank with the greatest use; 5 being the least used tank.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ "poly globe"

3 Please rank the following factors by relative importance as they relate to choosing portable tanks. 1 being the most important factor: 6 being the least important factor. - availability
__ waste volume
__ waste type
__ storage considerations
__ amount of paper work
__ portability and transportation

4 Rank the following containers based on their ease of transportation. 1, being the easiest to transport. Please mark N/A if you haven't used the container.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ "poly globe"

5 Please circle all responses that apply. When completing paperwork for waste management as ft relates to waste in a portable container what type of paperwork do you complete?
a label
b requisition
c sampling paperwork
d shipping papers
e Other. Please describe.

6 Rank the following containers, based on their relative ease of sampling. 1, being the easiest to sample, 5 being the most difficult to sample.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ “poly globe”

7 When transferring waste to a 330 gallon tank does this operation normally occur with in secondary containment?
a yes
b no

8 When transferring waste to a 660 gallon poly tank does this operation normally occur with in a secondary containment?
a yes
b no

9 When transferring waste to a 660 gallon stainless steel tank does this operation normally occur with in a secondary containment?
a yes
b no

10 When transferring waste to a 750 gallon steel tank does this operation normally occur with in a secondary containment?
a yes
b no

11 When transferring waste to a poly globe, does this operation normally occur with in a secondary containment?
a yes
b no

12 When using a 330 gallon tuff tank for storage of waste do you normally store this container:
a with in an impermeable secondary containment system.
b on an impermeable surface such as asphalt or cement.
c other.

13 When using a 660 gallon poly tank for waste storage do you normally store this container.
a with in an impermeable secondary containment system.
b on an impermeable surface such as asphalt or cement.
c other.

14 When using a 660 gallon stainless steel tank for waste storage do you normally store this container:
a with in an impermeable secondary containment system.
b on an impermeable surface such as asphalt or cement.
c other.

15 When using a 750 gallon steel tank for waste storage do you normally store this container:
a with in an impermeable secondary containment system.
b on an impermeable surface such as asphalt or cement.
c other.

16 When using a poly globe for waste storage do you normally store this container:
a with in an impermeable secondary containment system.
b on an impermeable surface such as asphalt or cement.
c other.

17 Rank the following tanks based on ease of rinsing and cleaning. 1 being the easiest to rinse and clean, 5 being the most difficult to rinse and clean.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ “poly globe”

18 Regarding the cleaning and rinsing of a portable container with waste having a significant amount of settleable solids (sludge), rank the following containers; 1 being the easiest to clean, 5 being the most difficult to clean.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ “poly globe”

19 Rank the following containers regarding spills of less than 2 gallons. 1 being the least spills, 5 have the greatest number of spills.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ “poly globe”

20 Rank the following conditions that relate to waste spillage of less than 2 gallons from a portable container. 1 being the most likely to contribute to a spill, 4 being the least likely to contribute to a spill.
__ transfer hose connection or disconnection over filling
__ over filling
__ splash over during transportation
__ waste-container compatibility

21 Rank the following containers regarding waste spills of greater than 10 gallons. 1 being the least number of spills, and 5, the greatest number of spills.
__ 330 gallon 'tuff tank'
__ 660 gallon 'poly tank'
__ 660 gallon stainless steel tank
__ 750 gallon steel tank
__ “poly globe”

22 Rank the following conditions that relate to waste spillage of greater than 1 0 gallons from a portable container. 1 being the most likely to contribute to a spill, 4 being the least likely to contribute to a spill.
__ transfer hose connection or disconnection over filling
__ over filling
__ splash over during transportation
__ waste-container compatibility

23 When storing waste in portable containers do you most frequently store waste in the containers for:
a less than 30 days
b from 30 days to 60 days
c from 60 days to 80 days
d from 80 to 120 days
e greater than 120 days.

24 If you could have only one type of portable tank for your operations, what would you use:
a 330 gallon 'tuff tank'
b 660 gallon 'poly tank'
c 660 gallon stainless steel tank
d 750 gallon steel tank
e “poly globe”

25 If you could have 2 types of portable containers for your operations which types would you use: Please circle the two appropriate letters.
a 330 gallon 'tuff tank'
b 660 gallon 'poly tank'
c 660 gallon stainless steel tank
d 750 gallon steel tank
e “poly globe”

Container Survey Summary: Environmental Restoration Division						
Where fractional values are given; they represent the average score of those responding in the survey. A score of 1 being the best and 5 the lowest.						
	330 g. tuff tank	660 g. poly tank	660 g. s. steel	750 g. s. steel	poly globe	# of responses
Most Frequently Used Portable Tank.	2.00	3.67	3.00	4.66	1.25	5.00
Ease Of Transportation	1.33	2.00	0.00	3.00	1.33	4.00
Ease Of Sampling	2.50	2.50	3.00	5.00	1.00	3.00
Ease Of Rinsing & Cleaning	2.33	3.00	4.67	3.67	1.25	3.00
Ease Of Rinsing W/ Solids	2.00	3.00	4.00	5.00	1.00	2.00
Least # Of Small Spills	3.50	2.50	4.00	4.00	1.00	2.00
Least # of Spills >10 gals.	1.00	3.00	4.00	5.00	2.00	1.00
Average	2.09	2.81	3.24	4.33	1.26	2.86
First Choice Of Portable Tank.	2		1		**3**	
First Two Choices Of Portable Tanks.	2	2	2	1	**3**	
	Hazardous	non-hazardous				
waste type handled	1	3				
	availability	waste volume	waste type	storage	paper work	transportable
Most important factors utilized in choosing portable tanks.	2.6	2.4	3.2	5.2	5.4	1.8
	label	requisition	sampling	shipping	other	
Types of paperwork completed.	4 of 4	4 of 4	1 of 4	no response	no response	
	Hose connect, or disconnect.	Over filling.	Splash over in transit.	Waste-tank compatibility.	Number surveyed.	
Reason for spills < 2 gallons.	1.67	2	2.33	4	3	
Reason for spills > 10 gallons.	3	2.67	2.67	1.67	3	

Container Survey Summary: Environmental Restoration Division						
Environmental Restoration Division	yes	no	# responding	% storage with in secondary containment		
Is waste transferred with in a secondary						
330 gallon tuff tank	1	1	2	0.50		
660 gallon poly tank	1	2	3	0.33		
660 stainless steel tank		2	2			
750 stainless steel tank		1	1			
poly globe		3	3			
	With in Secondary containment.	On an impermeable surface.	Other.	Number responding to question.		
Waste storage location						
330 gallon tuff tank	1			1		
660 poly tank				0		
660 stainless steel tank.				0		
750 stainless steel tank.				0		
Poly globe.				0		

Container Survey Summary: HWM Field Technicians						
The values represent an average. A low score indicates a positive response						
	330 g. tuff tank	660 g. poly tank	660 g. s. steel	750 g. s. steel	poly globe	# of responses
Most Frequently Used Portable Tank.	2.14	2.14	2.00	3.71	4.14	7
Ease Of Transportation	1.43	2.29	2.43	4.00	5.00	7
Ease Of Sampling	2.43	2.00	1.17	2.80	5.00	7
Ease Of Rinsing & Cleaning	2.43	2.14	1.86	3.17	3.67	7
Ease Of Rinsing W/ Solids	2.62	2.25	1.75	3.57	3.67	8
Least # Of Small Spills	2.75	2.75	2.25	2.33	4.00	2
Least # of Spills >10 gals.	3.00	2.00	2.00	3.00	5.00	1
Average	2.40	2.22	1.92	3.23	4.35	5.57
First Choice Of Portable Tank.	1	2	4	0	0	
First Two Choices Of Portable Tanks.	2	5	6	1	0	
	Hazardous	non-hazardous				
waste type handled	7	2				
	availability	waste volume	waste type	storage	paper work	transportable
Most important factors utilized in choosing portable tanks.	2.86	1.71	1.43	3.43	5.43	4.14
	label	requisition	sampling	shipping	other	
Types of paperwork completed.	7	7	7	0	0	
Factors leading to spillage.	Hose connect, or disconnect.	Over filling.	Splash over in transit.	Waste-tank compatibility.	Number surveyed.	
Reason for spills < 2 gallons.	1.5	2	2.5	4	6	
Reason for spills > 10 gallons.	3	2	2	3	5	

Container Survey Summary: HWM Field Technicians						
Is waste transferred with in a secondary containment system?	yes	no	#responding	% transferred with in secondary containment		
330 gallon tuff tank	2	6	8	25.00		
660 gallon poly tank	2	6	8	25.00		
660 stainless steel tank	2	6	8	25.00		
750 stainless steel tank	1	5	7	14.29		
poly globe	0	4	7	0.00		
	With in Secondary containment.	On an impermeable surface.	Other.	Percent storage with-in secondary containment	Number responding to question.	
Waste storage location						
330 gallon tuff tank	3	4	1	37.50	8	
660 poly tank	2	5	1	25.00	8	
660 stainless steel tank.	2	5	1	25.00	8	
750 stainless steel tank.	1	5		16.67	6	
Poly globe.	N/A	N/A	N/A		N/A	

Container Survey Summary: HWM - Liquid Waste Treatment						
Where fractional values are given; they represent the average score of those responding in the survey. The lower the score, the better.						
	330 g. tuff tank	660 g. poly tank	660 g. s. steel	750 g. s. steel	poly globe	# of responses
Most frequently used portable tank	3.40	2.80	1.40	2.40	5.00	5
Ease of transportation	3.00	2.60	1.40	2.80	5.00	5
Ease of sampling	2.20	2.40	1.80	2.40	5.00	5
Ease of rinsing & cleaning	3.20	2.40	1.00	2.60	5.00	5
Ease of rinsing with solids	4.00	2.75	1.25	1.75	5.00	5
Least number of small spills	4.50	3.33	2.00	2.50	5.00	4
Least number of spills >10 gals	3.67	3.00	2.00	3.33	5.00	3
Average	3.42	2.75	1.55	2.54	5.00	4.57
Number of respondants choosing this as the best over all container	0	0	5	0	0	5
Number of respondants choosing these as the best two containers	3	1	5	1	0	5
waste type handled	hazardous	non-hazardous				
Number of respondants	3	2				
Most important factors utilized in choosing portable tanks	availability	waste volume	waste type	storage	paper work	transportable
	3.4	2.25	2.4	4.5	6	4.75
Types of paperwork completed.	label	requisition	sampling	shipping	other	
Respondants completing paper work	5	4	3	2	3	
Factors leading to spillage	hose connect, or disconnect	over filling	splash over in transit	waste/container compatibility	number surveyed	
Reason for spills < 2 gallons	1	3	3.67	3.33	3	
Reason for spills > 10 gallons	1	3	3.67	3.33	3	

Container Survey Summary: HWM - Liquid Waste Treatment						
Is waste transferred within a secondary containment system?	yes	no	Number responding	percent transferred with in secondary containment		
330 gallon tuff tank	2	4	6	33.33		
660 poly tank	4	0	4	100.00		
660 stainless steel tank	5	0	5	100.00		
750 stainless steel tank	5	0	5	100.00		
Poly globe	1	NA	1	100.00		
Container storage location	with in secondary containment	on an impermeable surface	other	percent storage within secondary containment	number responding to question	
330 gallon tuff tank	4	1		80	5	
660 poly tank	4	1		80	5	
660 stainless steel tank	4	1		80	5	
750 stainless steel tank	4	1		80	5	
Poly globe	1	0		100	1	

Container Survey Summary: HWM Field Technicians - Site 300						
The values represent an average. A low score, indicates a positive response.						
	330 g. tuff tank	660 g. poly tank	660 g. s. steel	750 g. s. steel	poly globe	# of responses
Most frequently used portable tank	2.50	1.50	2.00	4.00	5.00	2
Ease of transportation	2.00	1.50	1.00	4.00	5.00	2
Ease of sampling	1.00	3.00	2.00	3.00	5.00	2
Ease of rinsing and cleaning	2.00	3.00	1.00	2.00	4.00	2
Ease of rinsing tanks with high solids	5.00	6.00	1.00	2.00	4.00	2
Least number of small spills	1.00	1.00	1.00			1
Least number of spills > 10 gal	1.00	1.00	1.00			1
Average	2.07	2.43	1.29	3.00	4.60	1.71
Number of respondants choosing this as the best over all container			2			
Number of respondants choosing these, as the best two containers		1	2	1		
Waste type handled	hazardous	non-hazardous				
Number of respondants	2	0				
Most important factors utilized in choosing portable tanks.	availability	waste volume	waste type	storage	paper work	transportable
Ranking of factors. The lower the score, the greater the importance.	2	3	4	3	5.5	3.5
Types of paperwork completed.	label	requisition	sampling	shipping	other	
Respondants completing paper work	2	2	2	2		
Factors leading to spillage.	hose connect, or disconnect	over filling	splash over in transit	waste-tank compatibility	number surveyed	
Reason for spills < 2 gallons.	2.5	3	3.5	4	2	
Reason for spills > 10 gallons.	3.5	2.5	3	4	2	

Container Survey Summary: HWM Field Technicians - Site 300						
Is waste transferred with in a secondary containment system?	yes	no	number responding	percent transferred with in secondary containment		
330 gallon tuff tank	1	1	2	50		
660 gallon poly tank	1	1	2	50		
660 stainless steel tank	1	1	2	50		
750 stainless steel tank	1	1	1	100		
poly globe		2	2	0		
container storage location	With in secondary containment	on an impermeable surface	other	percent storage within secondary containment	number responding to question.	
Waste storage location						
330 gallon tuff tank	2	1			2	
660 poly tank	2	1			2	
660 stainless steel tank.	2	1			2	
750 stainless steel tank.	1			100.00	1	
Poly globe.		1		0.00	1	

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